

1 KELLY M. KLAUS (SBN 161091)  
 kelly.klaus@mto.com  
 2 PETER A. DETRE (SBN 182619)  
 peter.detre@mto.com  
 3 TERESA A. REED DIPPO (SBN 315960)  
 teresa.reeddippo@mto.com  
 4 MUNGER, TOLLES & OLSON LLP  
 560 Mission Street, 27th Floor  
 5 San Francisco, California 94105-2907  
 Telephone: (415) 512-4000  
 6 Facsimile: (415) 512-4077  
 7 GINGER D. ANDERS (*pro hac vice*)  
 ginger.anders@mto.com  
 8 MUNGER, TOLLES & OLSON LLP  
 1155 F Street NW, 7th Floor  
 9 Washington, DC 20004-1343  
 Telephone: (202) 220-1100  
 10 Facsimile: (202) 220-2300  
 11 GLENN D. POMERANTZ (SBN 112503)  
 glenn.pomerantz@mto.com  
 12 ERIN J. COX (SBN 267954)  
 erin.cox@mto.com  
 13 JOHN L. SCHWAB (SBN 301386)  
 john.schwab@mto.com  
 14 MUNGER, TOLLES & OLSON LLP  
 350 South Grand Avenue, 50th Floor  
 15 Los Angeles, California 90071-3426  
 Telephone: (213) 683-9100  
 16 Facsimile: (213) 687-3702

17 *Attorneys for Defendants*

18 UNITED STATES DISTRICT COURT  
 19 NORTHERN DISTRICT OF CALIFORNIA  
 20 SAN FRANCISCO DIVISION

21 REARDEN LLC et al.,  
 Plaintiffs,

22 vs.

23 THE WALT DISNEY COMPANY et al.,  
 Defendants,

24 REARDEN LLC et al.,  
 Plaintiffs,

25 vs.

26 TWENTIETH CENTURY FOX FILM  
 27 CORPORATION et al.,  
 28 Defendants.

Case Nos. 3:17-cv-04006-JST  
 3:17-cv-04191-JST

**DECLARATION OF HAO LI IN  
 SUPPORT OF DEFENDANTS' MOTIONS  
 FOR SUMMARY JUDGMENT ON  
 CAUSAL NEXUS ISSUE**

Judge: Hon. Jon S. Tigar  
 Date: To be set  
 Time: To be set

Ctrm.: 9 (19th Floor)

1 I, Hao Li, hereby declare:

2 1. I am an assistant professor of Computer Science at the University of Southern California  
3 (“USC”) and the director of the Vision and Graphics Lab at the USC Institute for Creative  
4 Technologies. I submit this declaration in support of the Defendants’ Motion for Summary  
5 Judgment on the Causal Nexus Issue. I have personal knowledge of the facts set forth herein,  
6 except as to those stated on information and belief and, as to those, I am informed and believe  
7 them to be true. If called as a witness, I could and would testify competently to the facts stated  
8 herein.

9  
10 BACKGROUND AND QUALIFICATIONS

11 2. I work in the field of computer graphics and computer vision, with a focus on capturing  
12 and digitizing humans and their performances. I develop systems and algorithms for facial  
13 performance capture and processing. I also am the CEO and co-founder of Pinscreen, a company  
14 in Los Angeles that develops consumer-accessible three-dimensional (“3D”) avatar creation  
15 technology.

16 3. In 2011, I co-developed a performance-driven facial animation system called Faceshift,  
17 which was later acquired by Apple. I have been a research lead at the visual effects company  
18 Industrial Light & Magic; a visiting professor at the visual effects company Weta Digital; and a  
19 postdoctoral fellow at Columbia and Princeton Universities. In 2013, the MIT Technology  
20 Review named me a “top 35 innovator under 35” in recognition of my work in computer graphics.  
21 I also have been awarded the Google Faculty Award, the Okawa Foundation Research Grant, the  
22 Office of Naval Research Young Investigator Award, and the Andrew and Erna Viterbi Early  
23 Career Chair at the University of Southern California.

24 4. My descriptions of the facial motion capture process and of the use of outputs of that  
25 process in movie production are based on my research and academic experience, my own  
26 experience using outputs of the MOVA facial capture system while at the Industrial Light &  
27 Magic visual effects company, and my experience in movie production at the Weta Digital visual  
28 effects company.

1 5. A copy of my CV is attached as Exhibit A.

2  
3 ASSIGNMENT

4 6. The Studio Defendants have asked me to describe the following: how facial motion  
5 capture systems work generally; how the MOVA system works in particular; and the general work  
6 that is involved to create a computer-generated (“CG”) character after the MOVA system has been  
7 used to capture an actor’s facial performance and output files created.

8 7. In forming my opinions, I considered Rearden’s First Amended Complaint filed against  
9 Disney (Mar. 6, 2018), Dkt. 63 (No. 17-cv-04006).

10  
11 HOW FACIAL MOTION CAPTURE WORKS

12 8. “Facial motion capture” describes a method for recording and processing the elements of  
13 an actor’s facial movement for the purpose of animating a CG character’s face. A facial motion  
14 capture system comprises hardware and software elements. The hardware elements are the  
15 physical tools that are used in capturing an actor’s facial performance. The software element is  
16 the computer program that provides instructions for operating some of the hardware elements and  
17 processing the recorded data.

18 9. The two most common types of hardware used to capture an actor’s facial performance are  
19 head-mounted cameras and static capture settings. A head-mounted camera consists of a helmet  
20 with a mount that holds one or more cameras pointed toward the face of the person wearing the  
21 helmet. A static capture setting is a physical frame that surrounds the actor’s face during his  
22 performance. The frame may hold a single camera or an array of multiple cameras, as well as  
23 lights. Relative to a head-mounted camera, a static capture setting can make it easier to capture  
24 high-quality and high-resolution facial motion data because more cameras can be used; the actor’s  
25 head and body movements can be constrained (so that the face is always visible to cameras); and  
26 external lighting can be controlled.

27 10. The software element of a facial motion capture system runs on a computer (or computers)  
28 connected to the hardware and controls and directs its operation. The software instructs the

1 hardware when to start and stop recording, and instructs the lights and cameras in the physical  
2 system when to turn on and off. If the hardware includes multiple cameras, the software may  
3 synchronize the data captured from different cameras, each of which will have a different view of  
4 the actor. The software may also be used to reorganize the captured data and process the output  
5 files for later use in the CG animation process.

6 11. A facial motion capture system can produce data about how a subject's face appears and  
7 moves. That data can then be used in the process of controlling the movements of the "face" of a  
8 3D model.

9  
10 THE MOVA SYSTEM

11 12. MOVA Contour is one type of facial motion capture system. I refer to the overall system  
12 as the "MOVA system." The MOVA system includes hardware and software elements.

13 13. As to hardware, MOVA employs a static capture setting with multiple cameras, white  
14 lights, and ultraviolet ("UV") lights. During a capture session, the actor wears phosphorescent  
15 makeup that is sprayed over his entire face to create a random pattern. The makeup pattern is not  
16 visible under the white lights, but is visible under the UV lights, and allows the cameras to capture  
17 high-quality data that accurately represents the 3D motion of the captured face. When the capture  
18 hardware is operating, the white and UV lights flash on and off in very rapid alternate succession.  
19 The cameras digitally record the facial performance under both lighting conditions.

20 14. A number of personnel are typically involved in a facial motion capture session.

- 21 a. The actor or subject must be present to perform.
- 22 b. Another person, sometimes called a motion capture supervisor, directs the actor's
- 23 facial performance by leading the subject through relevant scenes or parts of
- 24 scenes. A motion capture supervisor may also ask the actor to perform a set of key
- 25 facial expressions based on or similar to the Facial Action Coding System
- 26 ("FACS"). FACS is a taxonomy that breaks down human facial expressions based
- 27 on the movements of individual muscles.
- 28

1 c. Other technical personnel are typically present to set up and operate various  
2 elements of the capture system, including to:

3 i. Ensure that the phosphorescent makeup is properly applied on the actor's  
4 face.

5 ii. Calibrate the cameras by positioning them in the capture setting and  
6 calculating the relative distances between and orientations of the cameras.  
7 The proper calibration of the cameras is important to the accuracy of the  
8 recorded data and its subsequent processing. Even a slight inaccuracy in the  
9 calibration can significantly deteriorate the capture quality.

10 iii. Manually control the motion capture software, including commanding the  
11 software to start and stop the recording.

12 iv. An engineer or other operator typically also organizes and stores the data  
13 that is collected.

14 15. I understand that Plaintiffs allege that temporary copies of MOVA software code are created in  
15 computer random access memory ("RAM") at two points in time: (1) when the MOVA system  
16 is utilized for the capture of facial motion data; and (2) when the MOVA system is utilized to  
17 process the captured data.

18 16. Software is normally stored on the hard drive of a computer. When the computer calls on the  
19 program, portions of the software code are typically copied into RAM to enable the use of the  
20 program.

21 17. When the MOVA system is used for the capture of facial motion data, the MOVA program  
22 would typically control the operation of the hardware's video recording operations, such as  
23 start recording, stop recording, turn lights on and off, and other setting adjustments. The  
24 software may also synchronize the data captured by multiple camera angles under both visible  
25 and UV light. The recordings of the captured data are stored on a hard drive.

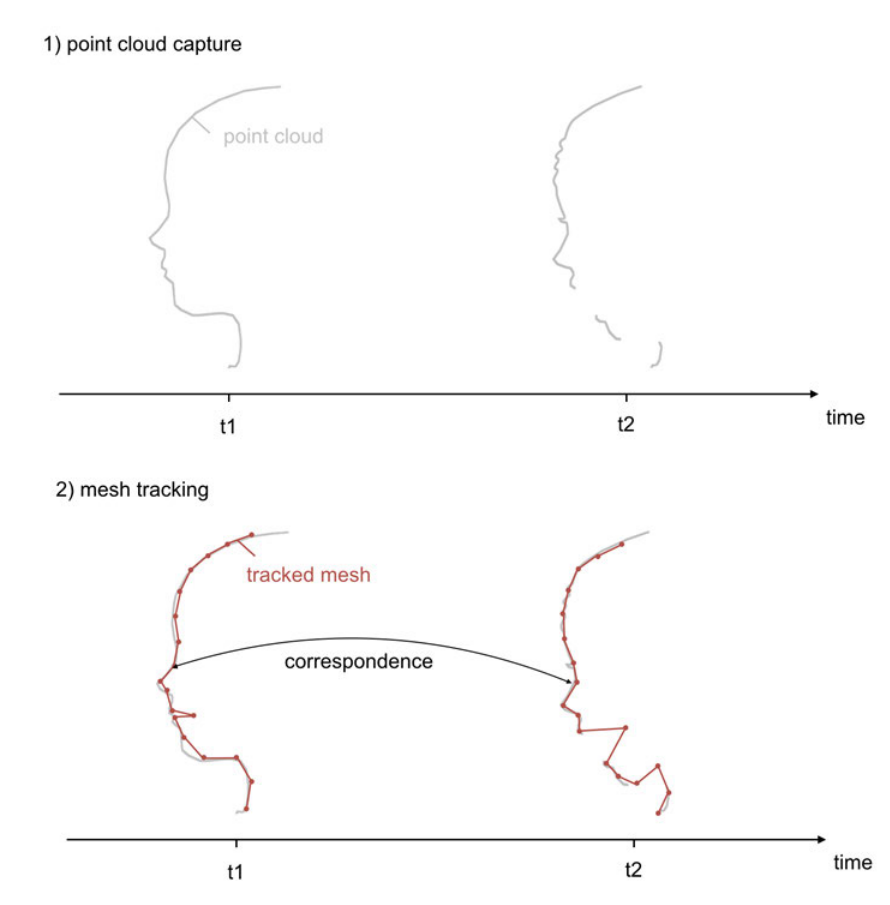
26 18. When the MOVA system is used to process captured data, the MOVA program would  
27 typically assist in generating output files. In particular, the MOVA software tracks points on  
28

1 the face across frames of captured motion data. The software assists in generating one or more  
2 output files that constitute the “tracked mesh.”

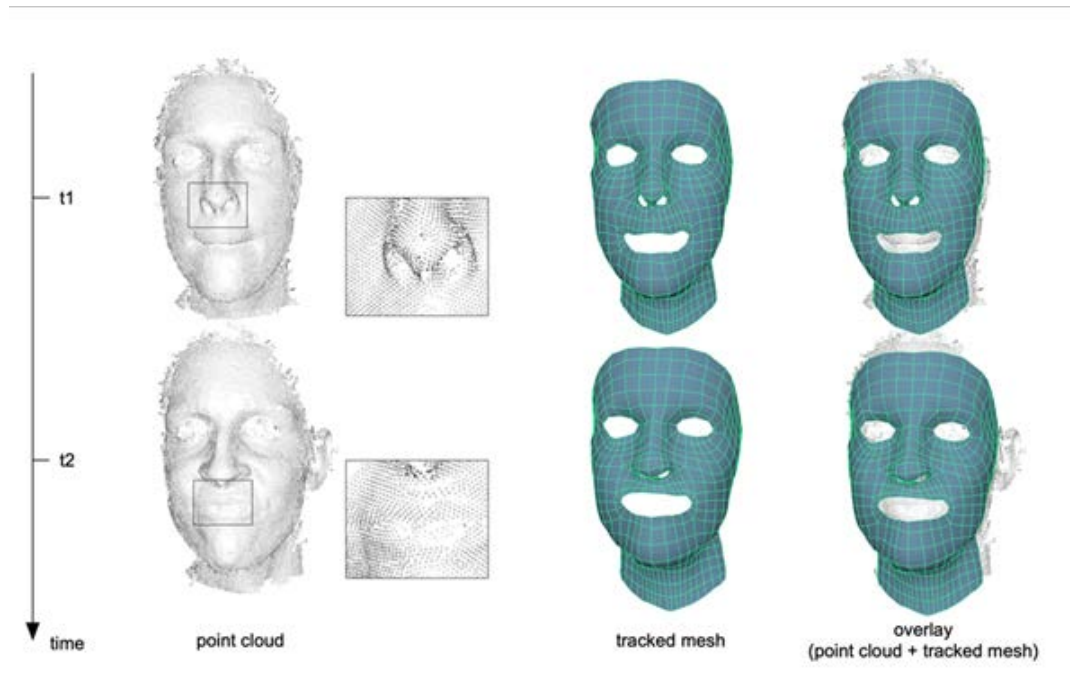
3 19. The following is a general overview of the process for creating the tracked mesh.

- 4 a. The captured video data is first translated into a “point cloud.” A point cloud is  
5 data which consists of the subject face represented by thousands of 3D coordinates  
6 in space (which can be plotted on  $x, y, z$  axes). Each frame of facial movement is  
7 associated with a unique point cloud. The point cloud is an imperfect instrument  
8 for tracking facial motion for animation purposes, because as the face moves across  
9 frames (*i.e.*, over time), the set of points in the point cloud does not remain  
10 consistent. In particular, correspondences between points from frame to frame  
11 cannot be determined.
- 12 b. The point cloud is modified into the tracked mesh through the identification of a set  
13 of specific points on the face that can be consistently tracked across frames. The  
14 end product of tracking points across frames of facial motion is a “tracked mesh.”  
15 The tracked mesh is made up of vertices, which are specific data points, and edges,  
16 which are line segments that connect the vertices. When rendered on a computer  
17 display, the tracked mesh will appear as a web-like diagram of the face. The  
18 vertices and edges will follow, or “track,” facial motion based on the movement of  
19 specific points on the face across multiple frames of a particular take of the actor’s  
20 facial performance.

- c. The following images use simplified solid-line, two-dimensional representations of a point cloud and tracked mesh to demonstrate how (1) the raw point cloud data does not permit consistent tracking of facial features across time and frames of facial movement; whereas (2) the tracked mesh data traces specific points on the face to create reliable correspondences that do permit consistent tracking across time and frames of facial movement.



- d. The following image shows point cloud data next to the corresponding wireframe tracked mesh. The vertical axis marks two different points in time to show how both the point cloud and the tracked mesh change as the face moves over time.



20. The tracked mesh is created in the following way.

- a. The vertices of a “generic mesh” are mapped onto the point cloud of the actor’s face, either manually or through software. The generic mesh is a coarse mesh form that is not based on a specific subject’s face, but has a general facial form with vertices that can be mapped onto the captured facial data of any subject. Once mapped onto the actor’s face, the mesh form is used to track the actor’s facial motion through frames of captured facial movement, and becomes the tracked mesh.
- b. The MOVA software supplies an algorithm that the engineer can use to adapt the mesh over time and across frames of facial capture data. The final tracked mesh incorporates the data from the selected sequence of facial motion capture.
- c. In my experience, the MOVA algorithm alone would not be sufficiently robust to track accurately all of the movements of the actor’s facial performance. For



1 example, automated tracking may produce errors due to a problem called “drift”  
2 which refers to the accumulation of small errors that are necessarily introduced by  
3 the algorithm in each frame because it is unable to track facial points with 100%  
4 accuracy across frames. In addition, the MOVA algorithm may not be able to  
5 reliably track facial points across frames when the change in facial expressions  
6 between consecutive frames is large—for example, when a neutral face is changed  
7 into an intense, angry face, with the actor’s mouth wide open. Therefore, an  
8 engineer must intervene to guide and adjust the tracking of the mesh. Without  
9 manual intervention, errors introduced by the algorithm would accumulate over  
10 time, leading to significant inaccuracies in the final tracked mesh, especially for  
11 complex recordings (which may be no longer than a few seconds if the facial  
12 motion is fast-paced or dramatic). These errors would make the tracked mesh  
13 unusable.

- 14 d. The tracked mesh that is produced does not cover critical regions of the face such  
15 as the skin around the eyes and the lip region (as well as teeth and tongue).  
16 Tracking is difficult in those regions because facial expressions are intricate. As a  
17 result, there is a significant amount of change in the geometry of points for tracking  
18 in those areas. The tracked mesh also does not cover the ears or the top and back of  
19 the head.

20  
21 USE OF THE OUTPUT FILES OF THE MOVA SYSTEM

22 21. The tracked mesh is delivered to the visual effects studio. The tracked mesh can be used by  
23 the visual effects studio to map the facial motion of the actor onto a computerized 3D model of  
24 the face of the target CG character. This 3D model is like a facial puppet that engineers and  
25 visual artists are able to manipulate to perform a broad range of facial expressions. I refer to  
26 this 3D model as the “target rig.” The visual effects studio may also use point cloud files and  
27 raw video footage of a capture session as reference material when the studio is creating the  
28 target rig.

- 1 22. The target rig is typically created by animators from scratch through a stylized artistic process.  
2 Animators also model the rig to form specific facial expressions, which are also created by  
3 hand. Animators may use modeling and animation software such as Maya, ZBrush, or Zeno to  
4 create the rig and also to change the rig's facial expressions, a process called "deforming."
- 5 23. Ultimately, the animators modify the shape of the target rig to perform the desired sequence of  
6 facial expressions for the character. The process of translating facial motion onto the rig is  
7 described as mapping or "retargeting."
- 8 24. The tracked mesh can be used to develop the target rig by deforming the rig to create specific  
9 facial expressions, thereby expanding the range of facial movement of the target rig. I am also  
10 aware that the tracked mesh can be used to assist with developing the animation of the target  
11 rig, by providing data about the actor's captured facial performance. The process of mapping  
12 the tracked mesh to the target rig involves the use of software that is not MOVA software.  
13 The additional software includes what is called a "retargeting solver." The retargeting solver  
14 translates the *xyz* coordinates of vertices in the tracked mesh into computer parameters that  
15 correspond to facial movements of the target rig. As the *xyz* coordinates of vertices in the  
16 tracked mesh vary, the parameters generated by the retargeting solver vary accordingly and  
17 result in corresponding movements of the facial expressions of the target rig.
- 18 25. Human involvement is extensive in the retargeting process. An artist may need to refine the  
19 rig to remedy inaccuracies or deficiencies of automatic tracking, such as, for example, the  
20 sticking together of the lips at the corners of the mouth. Digital artists may also refine the  
21 mapped performance for stylistic reasons, such as the director's preference for a more  
22 exaggerated facial expression. Digital artists will also need to add the movement of eye and  
23 lip regions, not fully captured by the tracked mesh, to the retargeted performance.
- 24 26. After retargeting, hundreds or even thousands of hours of human labor and artistry are still  
25 necessary to further develop the target rig and to create and animate the face of the character  
26 that appears onscreen.
- 27 a. *Modeling*: The face must be developed with color, texture, shading, and other  
28 details. The onscreen face of a CG character contains pore-level details, skin color

1 and tone, changes in texture (such as wrinkles for particular expressions), and even  
2 changes in skin tone based on emotion (for example, blood flow to the cheeks to  
3 depict anger). Any hair on the face and head must also be modeled. Each of these  
4 details is critical to the creation of the final character, and must be layered onto the  
5 target rig. These details may be the product of manual artistry or other techniques,  
6 none of which would involve the MOVA system. The work is often done by a  
7 separate, dedicated team. To model and perfect the additional details for a CG  
8 character's face requires weeks if not months of labor by multiple digital artists.

9 b. *Animation/Simulation*: As noted above, there are gaps in MOVA data that must be  
10 manually filled even for basic facial motion, such as deficiencies in automated  
11 tracking and in the motion of the eyes and lips. Additionally, certain specific kinds  
12 of facial movement are not captured by the performance-driven process, such as  
13 contact between a face and another object (*e.g.*, the punching of a face), or  
14 secondary facial motion caused by the character's movement (*e.g.*, jiggling when  
15 jumping or shaking the head). Animators must create all of this movement  
16 separately without the use of the MOVA system. For simulations, a technical  
17 director or animator will determine computer parameters to simulate the particular  
18 facial movement, essentially employing a trial and error process to adjust the  
19 parameters until it "looks right." Production teams typically include individuals  
20 who specialize in the particular job of refining these computer parameters. Once  
21 the computer parameters are satisfactory, the simulation may still require further  
22 refinement based on the artistic preference of the production team. This process  
23 can take weeks or months.

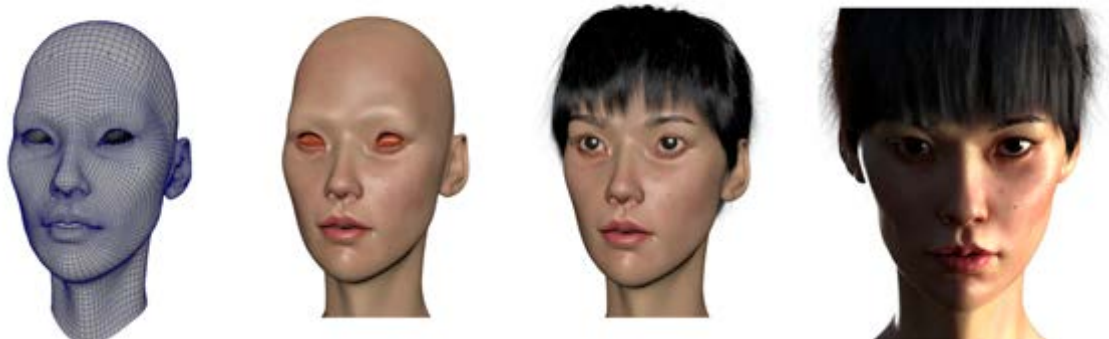
24 c. *Rendering*: All of the work up to this point creates a version of the character which  
25 is only visible on a computer through the use of 3D-viewer software. This version  
26 must be converted into a two-dimensional image that can be shown onscreen. That  
27 conversion process is called rendering, and includes all of the facial components—  
28 the shape and motion of the face, the color, the texture, the shading, and other

1 attributes. There is an entire team of digital artists (often ten or twenty individuals)  
2 that specialize in rendering. They select a rendering approach, set up or develop  
3 appropriate software, configure software parameters, and incorporate artistic  
4 direction (such as ensuring that the overall look matches the desired appearance of  
5 the character). This rendering process takes months. The final rendering must also  
6 incorporate the lighting and the illumination of the entire scene. That step of the  
7 process is highly human-assisted, and at the same time the automated computation  
8 of the rendering alone can take hours per frame. MOVA is not involved in this  
9 process.

10 27. The following images show an example of a target facial rig in various stages of development.

11 Moving from left to right:

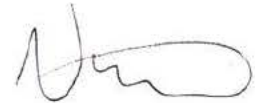
- 12 a. The first image shows the initial facial rig of a CG character with a neutral facial  
13 expression. This is how the rig appears immediately after the incorporation of facial  
14 motion data.
- 15 b. The second image shows the facial rig of the CG character with initial skin texturing,  
16 including color and facial features.
- 17 c. The third image shows the facial rig of the CG character with texturing and secondary  
18 components (such as eye balls and hair).
- 19 d. The fourth image shows the final rendered face of the CG character with texturing,  
20 secondary components, and lighting.



1 28. The final character also requires development of the body and voice.

- 2 a. *Body*: The MOVA system requires that the actor's body be still and involves only  
3 facial performance. Thus, a separate full-body capture session is typically  
4 necessary, using an appropriate system for capturing full-body motion. Typically,  
5 the performer will wear a specialized motion capture suit often with markers (*e.g.*,  
6 reflective balls) on it, and the body performance will be tracked using specialized  
7 high-speed cameras. As with the MOVA system, the data may be converted into a  
8 set of 3D points that can be retargeted to a model of the target CG character.  
9 Manual cleanup and adjustment is typically necessary after retargeting. Creation of  
10 the body performance may also require that certain extreme stunts be manually  
11 animated or simulated.
- 12 b. *Voice*: Voice performance may be done at the same time as MOVA-involved facial  
13 capture, on set, or separately; and the voice must then be incorporated into the final  
14 character. This process is typically less complex than the work that goes into the  
15 character's face, but it can still require hours of additional work, especially if there  
16 is a separate actor giving the voice performance.

17  
18 I declare under penalty of perjury under the laws of the United States that the foregoing is true  
19 and correct and that I executed this declaration this 27th day of February 2019 at  
20 Orlando, Florida.



21  
22  
23 Hao Li

# **EXHIBIT A**

HaoLi



CEO &amp; Co-Founder, Pinscreen Inc.

Assistant Professor of Computer Science, Andrew &amp; Erna Viterbi Early Career Chair, USC

Director of the Vision and Graphics Lab, USC Institute for Creative Technologies

University of Southern California  
Department of Computer Science  
941 Bloom Walk, SAL 244  
Los Angeles, CA 90089-0781, USA

Tel +1 917 514 6980  
Email hao@hao-li.com  
Home page http://www.hao-li.com/  
Facebook http://www.facebook.com/li.hao/

## PROFILE

Date of birth 17/01/1981  
Place of birth Saarbrücken, Germany  
Citizenship German  
Languages German, French, English, and Mandarin Chinese (all fluent and no accents)

## COMMITMENT

I work at the intersection between Computer Graphics, Computer Vision, and Machine Learning, with focus on photorealistic human digitization, real-time performance capture using deep learning and data-driven techniques. I'm known for my work in dynamic geometry processing, non-rigid registration, real-time facial performance capture, hair digitization, and 3D avatar modeling. My research has led to the facial animation technology in Apple's iPhone X, I worked on the digital reenactment of Paul Walker in the movie Furious 7, and my algorithms on deformable shape alignment have improved the radiation treatment for cancer patients all over the world.

I have been named one of the world's top 35 innovator under 35 by MIT Technology Review in 2013 and NextGen10: Innovators under 40 by C-Suite Quarterly in 2014. I received the Office of Naval Research (ONR) Young Investigator Award in 2018, the Google Faculty Research Award, the Okawa Foundation Research Grant, and the Andrew and Erna Viterbi Early Career Chair in 2015, the Swiss National Science Foundation fellowship for prospective researchers in 2011, and the best paper award at SCA 2009. I am ranked #1 on Microsoft Academic in 2016 on the top 10 leaderboard in Computer Graphics for the past five years. I am member of the Global Future Councils of the World Economic Forum (WEF) and co-organized the first CONIX Mixed Reality Workshop in 2018.

## Google Scholar

<https://scholar.google.com/citations?user=NFeigSoAAAAJ&hl=en>

## EDUCATION

**Ph. D., Computer Science** 07/2006 - 11/2010  
ETH Zurich, Department of Computer Science

- Thesis: *Animation Reconstruction of Deformable Surfaces*  
Advisor: Prof. M. Pauly

**M. Sc., Computer Science** 10/2000 - 01/2006  
Universität Karlsruhe (TH), Department of Computer Sciences

- Thesis: *Reconstruction of Colored Objects from Structured Illuminated Views*  
Advisor: Prof. H. Prautzsch
- Major 1: Computer graphics and geometric modeling
- Major 2: Cryptography and security
- Minor: Differential and projective geometry

**ERASMUS Student Exchange, Computer Science** 10/2002 - 09/2003  
Institut National Polytechnique de Grenoble, ENSIMAG

**French-German High School Diploma** 09/1992 - 05/1999  
Lycée Franco-Allemand de Sarrebruck, Germany



POSITIONS

---

<b>USC Institute for Creative Technologies</b> Director of the Vision and Graphics Lab	08/2016 - ongoing
<b>Pinscreen Inc.</b> CEO & Co-Founder	10/2015 - ongoing
<b>University of Southern California</b> Tenure-track Assistant Professor, Computer Science Department	08/2013 - ongoing
<b>Weta Digital</b> Visiting Professor, Virtual Studio Group	06/2014 - 08/2014
<b>Industrial Light &amp; Magic, Lucasfilm Ltd.</b> Research Lead, R&D Group	04/2012 - 07/2013
<b>Columbia University</b> Postdoctoral Fellow, Columbia Computer Graphics Group	04/2011 - 03/2012
<b>Princeton University</b> Visiting Postdoctoral Researcher, Princeton Computer Graphics Group	04/2011 - 03/2012
<b>École Polytechnique Fédérale de Lausanne</b> Visiting and Postdoctoral Researcher, Computer Graphics and Geometry Laboratory	02/2010 - 04/2011
<b>Industrial Light &amp; Magic, Lucasfilm Ltd.</b> Research Intern, R&D Group	07/2009 - 10/2009
<b>Stanford University</b> Visiting Researcher, Geometric Computing Group	07/2008 - 09/2008
<b>ETH Zurich</b> Research Assistant, Applied Geometry Group	07/2006 - 11/2010
<b>National University of Singapore</b> Visiting Research Scholar, Centre for Information Mining and Extraction	01/2006 - 07/2006

TEACHING

---

**Lecturer**

University of Southern California, Computer Science Department

- CSCI 621: Digital Geometry Processing (Lecture) SS 2017, SS 2018, and SS 2019
- CSCI 420: Computer Graphics (Lecture) FS 2014, FS 2015, FS 2017, and FS 2018
- CSCI 599: Digital Geometry Processing (Lecture) SS 2014 and SS 2015

**Guest Lecturer**

University of Southern California, Computer Science Department

- CSCI 576: Multimedia Systems Design (Lecture) FS 2016
- EE 598: Electrical Engineering Research Seminar (Lecture) SS 2016
- CSCI 697: Seminar in Computer Science Research (Lecture) FS 2015 and FS 2017
- CSCI 109: Introduction to Computing (Lecture) SS 2014 and FS 2015
- CSCI 597: Seminar in Computer Science Research (Lecture) FS 2013
- ENGR 102: Freshmen Academies (Lecture) FS 2013

Stanford University, Computer Science Department

- CS148: Introduction to Computer Graphics & Imaging (Lecture) 2012



Columbia University, Computer Science Department

- Computer Graphics (Lecture) 2011

### Teaching Assistant

École Polytechnique Fédérale de Lausanne, School of Computer and Communication Sciences

- Digital 3D Geometry Processing (Lecture) 2010
- Computer Graphics (Lecture) 2010

ETH Zurich, Department of Computer Science

- Surface Representation and Geometric Modeling (Lecture) 2007, 2008, and 2009
- Introduction to Computer Graphics (Lecture) 2006, 2007, 2008, and 2009
- Advanced Topics in Computer Graphics (Seminar) 2006 and 2007
- Geometric Computing (Seminar) 2008

## MENTORING

---

### Supervision

University of Southern California, Computer Science Department

- |  |                   |
|--|-------------------|
| • Kyle Morgenroth, PhD Student                                     | 09/2018 - ongoing |
| • Pengda Xiang, PhD Student  | 09/2018 - ongoing |
| • Haiwei Chen, PhD Student   | 09/2018 - ongoing |
| • Shichen Liu, PhD Student   | 09/2018 - ongoing |
| • Sitao Xiang, PhD Student   | 09/2016 - ongoing |
| • Zimo Li, PhD Student   | 09/2016 - ongoing |
| • Zeng Huang, PhD Student  | 09/2016 - ongoing |
| • Zhou Yi, PhD Student   | 09/2016 - ongoing |
| • Tianye Li, PhD Student (MSc in 2015)                             | 11/2015 - ongoing |
| • Shunsuke Saito, PhD Student                                      | 09/2015 - ongoing |
| • Kyle Olszewski, PhD Student                                      | 09/2014 - ongoing |
| • Lingyu Wei, PhD Student (PhD defense in 03/2018)                 | 09/2014 - 05/2018 |
| • Liwen Hu, PhD Student (MSc in 2013 and PhD defense in 11/2018)   | 09/2014 - 01/2019 |
| • Nitika Aggarwal, MSc Student                                     | 01/2014 - 05/2014 |
| • Ronald Yu, MSc Student (next stop: Stanford University)          | 10/2016 - 05/2018 |
| • Carrie Sun, BSc Student  | 01/2014 - 05/2014 |
| • Lizhi Fan, BSc Student   | 01/2015 - 05/2015 |
| • Natalie Monger, BSc Student                                      | 09/2016 - 05/2017 |
| • Dr. Chongyang Ma, Postdoctoral Researcher (next stop: Snap Inc.) | 09/2013 - 06/2015 |

USC Institute for Creative Technologies, Vision and Graphics Lab

- |   |                   |
|---|-------------------|
| • Kathleen Haase, Special Projects Manager                      | 06/2016 - ongoing |
| • Jun Xing, Postdoctoral Researcher                             | 05/2017 - ongoing |
| • Weikai Chen, Postdoctoral Researcher                          | 06/2017 - ongoing |
| • Yajie Zhao, Postdoctoral Researcher                           | 10/2017 - ongoing |
| • Mingming He, Postdoctoral Researcher                          | 12/2018 - ongoing |
| • Loc Huynh, PhD Student  | 08/2017 - ongoing |
| • Kalle Bladin, Research Programmer                             | 08/2017 - ongoing |
| • Pratusha Prasad, Research Programmer (MSc in 2016)            | 06/2016 - ongoing |
| • Xinglei Ren, Research Programmer (MSc in 2017)                | 04/2017 - ongoing |
| • Bipin Kishore, Research Programmer (MSc in 2017)              | 04/2017 - ongoing |
| • Chinmay Chinara, Research Programmer (MSc in 2018)            | 05/2018 - ongoing |
| • Aakash Shanbhag, Research Programmer (MSc in 2018)            | 05/2018 - ongoing |
| • Marcel Ramos, Digital Artist                                  | 06/2016 - ongoing |
| • Owen Ingraham, Digital Artist                                 | 07/2018 - ongoing |
| • Christina Trejo, Project Coordinator                          | 06/2016 - ongoing |
| • Andrew Jones, Sr. Research Associate (next stop: Raxium Inc.) | 06/2016 - 01/2018 |

Hao Li

4

## Columbia University, Computer Science Department

- Nathaniel Clinger, BSc Student 01/2012 - 05/2012
- Papoj Thamjaroenporn, BSc Student 01/2012 - 05/2012
- Pei-Lun Hsieh, MSc Student 01/2012 - 05/2012
- Xiaochen Hu, BSc Student 01/2012 - 05/2012

## EPFL, School of Computer and Communication Sciences

- Alexandru Ichim, MSc Student 06/2010 - 09/2010

## ETH Zurich, Department of Computer Science

- Huw Bowles, MSc Student 11/2008 - 05/2009
- Jens Puwein, MSc Student 02/2008 - 08/2008
- Jeroen Dries, MSc Student 09/2006 - 03/2007

## PhD Defense

- Liwen Hu, *University of Southern California* 11/2018
- Lingyu Wei, *University of Southern California* 03/2018
- Jens Windau, *University of Southern California* 11/2017
- Yi Guo, *University of Southern California* 03/2017
- Kai Chang, *University of Southern California* 02/2017
- Srinath Sridhar, *Saarland University / Max Planck Institute for Informatics* 12/2016
- Hongyi Xu, *University of Southern California* 11/2016
- Morten Bojsen-Hansen, *IST Austria* 07/2016
- Koki Nagano, *University of Southern California* 04/2016
- Sema Berkiten, *Princeton University* 02/2016
- Paul Graham, *University of Southern California* 05/2014
- Zhuoliang Kang, *University of Southern California* 04/2014

## PhD Qualifying Committee

- Yi Zhou, *University of Southern California* 01/2019
- Loc Huynh, *University of Southern California* 05/2018
- Weiyue Wang, *University of Southern California* 04/2018
- Chloe Legendre, *University of Southern California* 03/2018
- Lingyu Wei, *University of Southern California* 11/2017
- Yijing Li, *University of Southern California* 05/2017
- Sean Mason, *University of Southern California* 03/2017
- Soravit Changpinyo, *University of Southern California* 11/2016
- Yi Guo, *University of Southern California* 12/2015
- Inkyu Kim, *University of Southern California* 08/2016
- Matthias Hernandez, *University of Southern California* 05/2016
- Tran Tuan Anh, *University of Southern California* 04/2016
- Arnav Aghaarwal, *University of Southern California* 04/2016
- Kai Chang, *University of Southern California* 02/2016
- Ruizhe Wang, *University of Southern California* 12/2015
- Rongqi Qiu, *University of Southern California* 08/2015
- Christian Potthast, *University of Southern California* 05/2015
- Kai Chang, *University of Southern California* 05/2015
- Guan Pang, *University of Southern California* 05/2014
- Mohammad Abdel-Majeed, *University of Southern California* 03/2014
- Paul Graham, *University of Southern California* 09/2013
- Andrew Jones, *University of Southern California* 09/2013
- Morten Bojsen-Hansen, *IST Austria* 07/2012
- Breannan Smith, *Columbia University* 03/2012

## Outreach

## University of Southern California, Computer Science Department

- USC Viterbi EngX 2019 (ONR STEM)
- USC London Hackathon 2018

- USC Academic Career Mentoring Panel 2017
- USC Viterbi K-12 STEM: Coding and Animation (Screening and Panel) 2015

ACADEMIC SERVICES

---

University of Southern California, Computer Science Department

- SCA IMGD / CSGames Faculty Tenure Committee, FS 2018
- CS Department PhD Admissions Committee, FS 2018
- SCA IMGD / CSGames Faculty Search Committee, SS 2018
- CS Department PhD Admissions Committee, FS 2017
- Annual Faculty Merit Review Committee, SS 2017
- CS Department PhD Admissions Committee, FS 2016
- CS Department Faculty Search Committee, FS 2015
- CS Department PhD Admissions Committee, FS 2015
- CS Department Faculty Search Committee, FS 2014
- CS Department Transformative Committee, FS 2013
- Co-Chair of CS Department Colloquium Committee, FS 2013

CONSULTING

---

Munger, Tolles & Olson LLP	10/2018 - ongoing
Huawei	09/2015 - 09/2016
LEIA, Inc.	04/2015 - 10/2015
L Squared Capital Partners	03/2015 - 04/2015
Oculus VR/Facebook	08/2014 - 07/2015
Embodee Corp.	03/2014 - 05/2015
Pelican Imaging	02/2014 - 11/2016
Innored, Inc.	09/2013 - 01/2014
Disney Research Zurich	09/2013 - 09/2016
Industrial Light & Magic, Lucasfilm Ltd.	07/2013 - 06/2014
The Jig Lab	07/2013 - 05/2014
Tuxedo Agency	11/2012 - 11/2012
Artec Group, Inc	08/2011 - 12/2014
3Gear Systems	05/2011 - 04/2012
XYZ RGB, Inc.	07/2011 - 01/2012
Max Planck Institute for Intelligent Systems	05/2011 - 11/2011
C-RAD AB	08/2010 - 08/2011
Mova LLC	08/2010 - 10/2010
Filmakademie Baden-Württemberg GmbH, Institute for Animation	04/2010 - 07/2010
Aguru Images, Inc.	08/2008 - 07/2009

RESEARCH GRANTS & GIFTS

---

**Total Funding Awarded to PI:** \$13,621,159, where \$3,507,525 for USC and \$10,113,634 for USC/ICT.

**Federal Funding (\$8,892,055)**

U.S. Government

Project Nexus: Lifelike Digital Human Replica

Duration: 09/01/2018 – 08/31/2019

Award Amount: \$1,000,000

Role: PI (USC/ICT)

Army Research Office (ARO)

RTO: Scalable and Efficient Light Stage Pipeline for High-Fidelity Face Digitization

Duration: 09/01/2018 – 08/31/2019

Award Amount: \$200,000

Hao Li

6

Role: PI (USC/ICT)  
 U.S. Army Natick (NATICK)  
 High-Fidelity Rigging and Shading of Virtual Soldiers  
 Duration: 09/01/2018 – 03/31/2019  
 Award Amount: \$157,500  
 Role: PI (USC/ICT)

Office of Naval Research (ONR - HPTE)  
 Young Investigator Program (YIP): Complete Human Digitization and Unconstrained Performance Capture  
 Duration: 06/01/2018 - 05/31/2021  
 Award Amount: \$591,509  
 Role: PI (USC)

Semiconductor Research Corporation (SRC) / Defense Advanced Research Projects Agency (DARPA)  
 JUMP: Computing On Network Infrastructure for Pervasive, Cognition, and Action  
 Duration: 01/01/2018 - 12/31/2022  
 Award Amount: \$1,174,818  
 Role: PI (USC)

Army Research Office (ARO)  
 UARC 6.1/6.2: Avatar Digitization & Immersive Communication Using Deep Learning  
 Duration: 11/01/2017 - 10/31/2019  
 Award Amount: \$2,821,000  
 Role: PI (USC/ICT)

Army Research Office (ARO)  
 RTO: Strip-Based Hair Modeling Using Virtual Reality  
 Duration: 11/01/2017 - 10/31/2018  
 Award Amount: \$250,000  
 Role: PI (USC/ICT)

Army Research Office (ARO)  
 RTO: Head-Mounted Facial Capture & Rendering for Augmented Reality  
 Duration: 11/01/2017 - 10/31/2018  
 Award Amount: \$200,000  
 Role: PI (USC/ICT)

Army Research Office (ARO)  
 UARC 6.1/6.2: Capture, Rendering, & Display for Virtual Humans  
 Duration: 11/01/2016 - 10/31/2017  
 Award Amount: \$1,408,011  
 Role: PI (USC/ICT)

United States SHARP Academy (ARO)  
 Digital SHARP Survivor  
 Duration: 07/01/2016 - 06/31/2017  
 Award Amount: \$94,953  
 Role: PI (USC/ICT)

Army Research Office (ARO)  
 RTO: Lighting Reproduction for RGB Camouflage  
 Duration: 01/01/2016 - 12/31/2017  
 Award Amount: \$200,000  
 Role: PI (USC/ICT)

U.S. Army Natick (NATICK)  
 Research Contract  
 Duration: 09/01/2015 - 12/31/2016  
 Award Amount: \$145,000  
 Role: PI (USC/ICT)

Office of Naval Research (ONR)  
 Markerless Performance Capture for Automated Functional Movement Screening  
 Duration: 08/01/2015 - 09/30/2017  
 Award Amount: \$230,000  
 Role: PI (USC)

Intelligence Advanced Research Projects Activity (IARPA), Department of Defense (DoD)  
 GLAIVE: Graphics and Learning Aided Vision Engine for Janus  
 Duration: 07/25/2014 - 07/24/2018  
 Award Amount: \$419,264  
 Role: Co-PI (USC)

**Industry Funding (\$3,140,938)**

Softbank Corp.  
 3D Modeled, Rigged, and Animated Characters from 2D Video  
 Duration: 01/01/2019 – 01/01/2020  
 Award Amount: \$111,534  
 Role: Co-PI (USC)

Snap Inc.  
 Research Gift Donation  
 Date: 10/29/2018  
 Award Amount: \$20,000  
 Role: PI (USC)

TOEI Company, Ltd.  
 Research Contract  
 Duration: 06/01/2018 – 03/01/2019  
 Award Amount: \$580,000  
 Role: PI (USC/ICT)

Lightstage, LLC / Otoy  
 Research Contract  
 Duration: 05/15/2018 – 12/31/2018  
 Award Amount: \$152,000  
 Role: PI (USC/ICT)

Sony Corporation  
 Highly Sparse Volumetric Capture Using Deep Learning  
 Duration: 05/01/2018 - 04/31/2019  
 Award Amount: \$120,000  
 Role: PI (USC)

Sony Corporation  
 Geometry and Appearance Synthesis for 3D Human Performance Capture  
 Duration: 05/01/2017 - 04/31/2018  
 Award Amount: \$120,000  
 Role: PI (USC)

Hao Li

8

Adobe Systems Inc.  
Research Gift Donation  
Date: 08/09/2017  
Award Amount: \$20,000  
Role: PI (USC)

Mediafront Inc.  
Research Contract  
Date: 06/28/2017  
Award Amount: \$38,095  
Role: PI (USC/ICT)

Activision Publishing Inc.  
Research Contract  
Date: 05/09/2017  
Award Amount: \$21,593  
Role: PI (USC/ICT)

Electronic Arts Inc.  
Research Contract  
Duration: 12/01/2016 - 12/01/2018  
Award Amount: \$460,000  
Role: PI (USC/ICT)

SOOVII Digital Media Technology, Ltd  
Research Contract  
Date: 11/01/2016  
Award Amount: \$1,080,000  
Role: PI (USC/ICT)

RL Leaders, LLC  
Research Contract  
Date: 10/01/2016  
Award Amount: \$630,216  
Role: PI (USC/ICT)

Sony Corporation  
Shape and Reflectance Estimation via Polarization Analysis  
Duration: 08/12/2016 - 08/23/2017  
Award Amount: \$50,000  
Role: PI (USC/ICT)

Adobe Systems Inc.  
Research Gift Donation  
Date: 01/07/2016  
Award Amount: \$10,000  
Role: PI (USC)

Sony Corporation  
Unconstrained Dynamic Shape Capture  
Duration: 11/01/2015 - 10/31/2016  
Award Amount: \$123,500  
Role: PI (USC)

Hao Li

9

Facebook / Oculus  
Facebook Award  
Date: 10/14/2015  
Award Amount: \$25,000  
Role: PI (USC)

Huawei  
Development of a 3D Hair Database  
Date: 09/01/2015  
Award Amount: \$50,000  
Role: PI (USC)

Okawa Foundation  
Okawa Foundation Award  
Date: 10/08/2015  
Award Amount: \$10,000  
Role: PI (USC)

Adobe Systems Inc.  
Research Gift Donation  
Date: 04/27/2015  
Award Amount: \$9,000  
Role: PI (USC)

Embodee Corporation  
Research Gift Donation  
Date: 03/17/2015  
Award Amount: \$70,000  
Role: PI (USC)

Google  
Google Faculty Research Award: Data-Driven Framework for Unified Face and Hair Digitization  
Date: 02/12/2015  
Award Amount: \$52,000  
Role: PI (USC)

Facebook / Oculus  
Facebook Award  
Date: 02/03/2015  
Award Amount: \$25,000  
Role: PI (USC)

Panasonic Corporation  
Markerless Real-Time Facial Performance Capture  
Date: 09/22/2014  
Award Amount: \$20,000  
Role: PI (USC)

Pelican Imaging Corporation  
Research Gift Donation  
Date: 07/22/2014  
Award Amount: \$50,000  
Role: PI (USC)

Hao Li

10

Innored Inc.  
 Research Gift Donation  
 Date: 11/01/2013  
 Award Amount: \$25,000  
 Role: PI (USC)

#### **University Funding (\$856,166)**

USC Shoah Foundation Institute  
 New Dimensions in Testimony  
 Duration: 05/01/2016 - 09/31/2017  
 Award Amount: \$625,266  
 Role: PI (USC/ICT)

University of Southern California  
 Andrew and Erna Viterbi Early Career Chair  
 Start Date: 08/16/2015  
 Award Amount: \$20,000 (to date)  
 Role: PI (USC)

University of Southern California - Integrated Media System Center (IMSC)  
 IMSC Award  
 Duration: 07/01/2013 - 06/30/2014  
 Award Amount: \$11,000  
 Role: PI (USC)

University of Southern California  
 USC Start-up Funding  
 Start Date: 09/01/2013  
 Award Amount: \$199,900  
 Role: PI (USC)

#### AWARDS & HONORS

Office of Naval Research (ONR) Young Investigator Program (YIP) Award	02/2018
USC Stevens Commercialization Award	05/2017
Microsoft Academic Top 10 Leaderboard in the past 5 years in Computer Graphics (ranking #1)	05/2016
World Technology Award Fellow	10/2015
Andrew and Erna Viterbi Early Career Chair	10/2015
Okawa Foundation Research Grant	09/2015
Google Faculty Research Award	02/2015
C-Suite Quaterly NextGen 10: Innovators under 40	01/2014
World's top 35 innovator under 35 by MIT Technology Review	08/2013
Swiss National Science Foundation fellowship for prospective researchers	03/2011
ACM Symposium on Computer Animation Best Paper Award '09	08/2009
National Science Foundation 3DPVT '06 Student Travel Stipend	05/2006
German Academic Exchange Service (DAAD) fellowship	01/2006
Karl-Steinbuch scholarship of the MFG Baden-Württemberg	10/2005
Thomas Gessmann-Stiftung fellowship, German Science Foundation	09/2004
Baden-Württemberg scholarship of the Markel Foundation	10/2004
Scholarship of the Richard Winter foundation	09/2004
ERASMUS scholarship	10/2002
E-fellows scholarship	11/2001



**[51] PAGAN: REAL-TIME AVATARS USING DYNAMIC TEXTURES**

Koki Nagano, Jaewoo Seo, Jun Xing, Lingyu Wei, Zimo Li, Shunsuke Saito, Aviral Agarwal, Jens Fursund, Hao Li  
*ACM Transactions on Graphics, Proceedings of the 11th ACM SIGGRAPH Conference and Exhibition in Asia (SIGGRAPH Asia 2018), 12/2018*

**[50] 3D HAIR SYNTHESIS USING VOLUMETRIC VARIATIONAL AUTOENCODERS**

Shunsuke Saito, Liwen Hu, Chongyang Ma, Hikaru Ibayashi, Linjie Luo, Hao Li  
*ACM Transactions on Graphics, Proceedings of the 11th ACM SIGGRAPH Conference and Exhibition in Asia (SIGGRAPH Asia 2018), 12/2018*

**[49] REAL-TIME HAIR RENDERING USING SEQUENTIAL ADVERSARIAL NETWORKS**

Lingyu Wei, Liwen Hu, Vladimir Kim, Ersin Yumer, Hao Li  
*Proceedings of the 15th European Conference on Computer Vision, (ECCV 2018), 09/2018*

**[48] HAIRNET: SINGLE-VIEW HAIR RECONSTRUCTION USING CONVOLUTIONAL NEURAL NETWORKS**

Yi Zhou, Liwen Hu, Jun Xing, Weikai Chen, Han-Wei Kung, Xin Tong, Hao Li  
*Proceedings of the 15th European Conference on Computer Vision, (ECCV 2018), 09/2018*

**[47] DEEP VOLUMETRIC VIDEO FROM VERY SPARSE MULTI-VIEW PERFORMANCE CAPTURE**

Zeng Huang, Tianye Li, Weikai Chen, Yajie Zhao, Jun Xing, Chloe LeGendre, Linjie Luo, Chongyang Ma, Hao Li  
*Proceedings of the 15th European Conference on Computer Vision, (ECCV 2018), 09/2018*

**[46] HYBRID FUSION: REAL-TIME PERFORMANCE CAPTURE USING A SINGLE DEPTH SENSOR AND SPARSE IMUS**

Zerong Zheng, Tao Yu, Hao Li, Kaiwen Guo, Qionghai Dai, Lu Fang, Yebin Liu  
*Proceedings of the 15th European Conference on Computer Vision, (ECCV 2018), 09/2018*

**[45] CONTEXTUAL-BASED IMAGE INPAINTING: INFER, MATCH, AND TRANSLATE**

Yuhang Song, Chao Yang, Zhe Lin, Xiaofeng Liu, Qin Huang, Hao Li, C.-C. Jay Kuo  
*Proceedings of the 15th European Conference on Computer Vision, (ECCV 2018), 09/2018*

**[44] HIGH-FIDELITY FACIAL REFLECTANCE AND GEOMETRY INFERENCE FROM AN UNCONSTRAINED IMAGE**

Shugo Yamaguchi, Shunsuke Saito, Koki Nagano, Yajie Zhao, Weikai Chen, Kyle Olszewski, Shigeo Morishima, Hao Li  
*ACM Transactions on Graphics, Proceedings of the 45th ACM SIGGRAPH Conference and Exhibition (SIGGRAPH 2018), 08/2018*

**[43] MESOSCOPIC FACIAL GEOMETRY INFERENCE USING DEEP NEURAL NETWORKS**

Loc Huynh, Weikai Chen, Shunsuke Saito, Jun Xing, Koki Nagano, Andrew Jones, Paul Debevec, Hao Li  
*Proceedings of the 31st IEEE International Conference on Computer Vision and Pattern Recognition, (CVPR 2018 Spotlight Presentation), 06/2018*

**[42] DOUBLE FUSION: REAL-TIME CAPTURE OF HUMAN PERFORMANCES WITH INNER BODY SHAPES FROM A SINGLE DEPTH SENSOR**

Tao Yu, Zerong Zheng, Kaiwen Guo, Jianhui Zhao, Qionghai Dai, Hao Li, Gerard Pons-Moll, Yebin Liu  
*Proceedings of the 31st IEEE International Conference on Computer Vision and Pattern Recognition, (CVPR 2018 Oral Presentation), 06/2018*

**[41] AUTO-CONDITIONED RECURRENT NETWORKS FOR EXTENDED COMPLEX HUMAN MOTION SYNTHESIS**

Zimo Li, Yi Zhou, Shuangjio Xiao, Chong He, Zeng Huang, Hao Li

*Proceedings of the Sixth International Conference on Learning Representations, arXiv:1707.05363, (ICLR 2018), 04/2018*

**[40] AVATAR DIGITIZATION FROM A SINGLE IMAGE FOR REAL-TIME RENDERING**

Liwen Hu, Shunsuke Saito, Lingyu Wei, Koki Nagano, Jaewoo Seo, Jens Fursund, Iman Sadeghi, Carrie Sun, Yen-Chun Chen, Hao Li

*ACM Transactions on Graphics, Proceedings of the 10th ACM SIGGRAPH Conference and Exhibition in Asia (SIGGRAPH Asia 2017), 11/2017*

**[39] LEARNING A MODEL OF FACIAL SHAPE AND EXPRESSION FROM 4D SCANS**

Tianye Li, Timo Bolkart, Michael J. Black, Hao Li, Javier Romero

*ACM Transactions on Graphics, Proceedings of the 10th ACM SIGGRAPH Conference and Exhibition in Asia (SIGGRAPH Asia 2017), 11/2017*

**[38] LEARNING DENSE FACIAL CORRESPONDENCES IN UNCONSTRAINED IMAGES**

Ronald Yu, Shunsuke Saito, Haoxiang Li, Duygu Ceylan, Hao Li

*Proceedings of the IEEE International Conference on Computer Vision 2017 (ICCV 2017), 10/2017*

**[37] REALISTIC DYNAMIC FACIAL TEXTURES FROM A SINGLE IMAGE USING GANS**

Kyle Olszewski, Zimo Li, Chao Yang, Yi Zhou, Ronald Yu, Zeng Huang, Sitao Xiang, Shunsuke Saito, Pushmeet Kohli, Hao Li

*Proceedings of the IEEE International Conference on Computer Vision 2017 (ICCV 2017), 10/2017*

**[36] PRODUCTION-LEVEL FACIAL PERFORMANCE CAPTURE USING DEEP CONVOLUTIONAL NEURAL NET-WORKS**

Samuli Laine, Tero Karras, Timo Aila, Antti Herva, Shunsuke Saito, Ronald Yu, Hao Li, Jaakko Lehtinen

*Proceedings of the 16th ACM SIGGRAPH / Eurographics Symposium on Computer Animation, arXiv:1609.06536 (SCA 2017), 07/2017*

**[35] PHOTOREALISTIC FACIAL TEXTURE INFERENCE USING DEEP NEURAL NETWORKS**

Shunsuke Saito, Lingyu Wei, Liwen Hu, Koki Nagano, Hao Li

*Proceedings of the 30th IEEE International Conference on Computer Vision and Pattern Recognition, arXiv:1612.00523 (CVPR 2017 Spotlight Presentation), 07/2017*

**[34] HIGH-RESOLUTION IMAGE INPAINTING USING MULTI-SCALE NEURAL PATCH SYNTHESIS**

Chao Yang, Xin Lu, Zhe Lin, Eli Shechtman, Oliver Wang, Hao Li

*Proceedings of the 30th IEEE International Conference on Computer Vision and Pattern Recognition, arXiv:1611.09969 (CVPR 2017), 07/2017*

**[33] SIMULATION-READY HAIR CAPTURE**

Liwen Hu, Derek Bradley, Hao Li, Thabo Beeler

*Computer Graphics Forum 36(2), Proceedings of the 38th Annual Conference of the European Association for Computer Graphics (Eurographics 2017), 04/2017*

**[32] MULTI-VIEW STEREO ON CONSISTENT FACE TOPOLOGY**

Graham Fyffe, Koki Nagano, Loc Huynh, Shunsuke Saito, Jay Bush, Andrew Jones, Hao Li, Paul Debevec

*Computer Graphics Forum 36(2), Proceedings of the 38th Annual Conference of the European Association for Computer Graphics (Eurographics 2017), 04/2017*

**[31] LEARNING DETAIL TRANSFER BASED ON GEOMETRIC FEATURES**

Sema Berkiten, Maciej Halber, Justin Solomon, Chongyang Ma, Hao Li, Szymon Rusinkiewicz  
*Computer Graphics Forum* 36(2), *Proceedings of the 38th Annual Conference of the European Association for Computer Graphics (Eurographics 2017)*, 04/2017

**[30] HIGH-FIDELITY FACIAL AND SPEECH ANIMATION FOR VR HMDS**

Kyle Olszewski, Joseph J. Lim, Shunsuke Saito, Hao Li  
*ACM Transactions on Graphics, Proceedings of the 9th ACM SIGGRAPH Conference and Exhibition in Asia (SIGGRAPH Asia 2016)*, 12/2016

**[29] REAL-TIME FACIAL SEGMENTATION AND PERFORMANCE CAPTURE FROM RGB INPUT**

Shunsuke Saito, Tianye Li, Hao Li  
*Proceedings of the 14th European Conference on Computer Vision, arXiv:1604.02801 (ECCV 2016)*, 10/2016

**[28] CAPTURING DYNAMIC TEXTURED SURFACES OF MOVING TARGETS**

Ruizhe Wang, Lingyu Wei, Etienne Vouga, Qixing Huang, Duygu Ceylan, Gerard Medioni, Hao Li  
*Proceedings of the 14th European Conference on Computer Vision, arXiv:1604.02801 (ECCV 2016 Spotlight Presentation)*, 10/2016

**[27] DENSE HUMAN BODY CORRESPONDENCES USING CONVOLUTIONAL NETWORKS**

Lingyu Wei, Qixing Huang, Duygu Ceylan, Etienne Vouga, Hao Li  
*Proceedings of the 29th IEEE International Conference on Computer Vision and Pattern Recognition, arXiv:1511.05904 (CVPR 2016 Oral Presentation)*, 06/2016

**[26] RAPID PHOTOREALISTIC BLENDSHAPE MODELING FROM RGB-D SENSORS**

Dan Casas, Andrew Feng, Oleg Alexander, Graham Fyffe, Paul Debevec, Ryosuke Ichikari, Hao Li, Kyle Olszewski, Evan Suma, Ari Shapiro  
*Computer Animation and Virtual Worlds 2016, Proceedings of the 29th Conference on Computer Animation and Social Agents (CASA 2016)*, 05/2016

**[25] PATIENT-SPECIFIC ASSESSMENT OF DYSMORPHISM OF THE FEMORAL HEAD-NECK JUNCTION: A STATISTICAL SHAPE MODEL APPROACH**

Vikas Khanduja, Nick Baelde, Andreas Dobbelaere, Jan Van Houcke, Hao Li, Christophe Pattyn, Emmanuel A. Audenaert  
*The International Journal of Medical Robotics and Computer Assisted Surgery 2015 (MRCAS 2015)*, 12/2015

**[24] FACIAL PERFORMANCE SENSING HEAD-MOUNTED DISPLAY**

Hao Li, Laura Trutoiu, Kyle Olszewski, Lingyu Wei, Tristan Trutna, Pei-Lun Hsieh, Aaron Nicholls, Chongyang Ma  
*ACM Transactions on Graphics, Proceedings of the 42nd ACM SIGGRAPH Conference and Exhibition (SIGGRAPH 2015)*, 08/2015

**[23] SINGLE-VIEW HAIR MODELING USING A HAIRSTYLE DATABASE**

Liwen Hu, Chongyang Ma, Linjie Luo, Hao Li  
*ACM Transactions on Graphics, Proceedings of the 42nd ACM SIGGRAPH Conference and Exhibition (SIGGRAPH 2015)*, 08/2015

**[22] SKIN MICROSTRUCTURE DEFORMATION WITH DISPLACEMENT MAP CONVOLUTION**

Koki Nagano, Graham Fyffe, Oleg Alexander, Jernej Barbič, Hao Li, Abhijeet Ghosh, Paul Debevec  
*ACM Transactions on Graphics, Proceedings of the 42nd ACM SIGGRAPH Conference and Exhibition (SIGGRAPH 2015)*, 08/2015

**[21] UNCONSTRAINED REALTIME FACIAL PERFORMANCE CAPTURE**

Pei-Lun Hsieh, Chongyang Ma, Jihun Yu, Hao Li

*Proceedings of the 28th IEEE International Conference on Computer Vision and Pattern Recognition (CVPR 2015)*, 06/2015

**[20] CAPTURING BRAIDED HAIRSTYLES**

Liwen Hu, Chongyang Ma, Linjie Luo, Li-Yi Wei, Hao Li

*ACM Transactions on Graphics, Proceedings of the 7th ACM SIGGRAPH Conference and Exhibition in Asia (SIGGRAPH Asia 2014)*, 12/2014

**[19] ROBUST HAIR CAPTURE USING SIMULATED EXAMPLES**

Liwen Hu, Chongyang Ma, Linjie Luo, Hao Li

*ACM Transactions on Graphics, Proceedings of the 41st ACM SIGGRAPH Conference and Exhibition (SIGGRAPH 2014)*, 08/2014

**[18] RAPID AVATAR CAPTURE AND SIMULATION USING COMMODITY DEPTH SENSORS**

Ari Shapiro, Andrew Feng, Ruizhe Wang, Hao Li, Mark Bolas, Gerard Medioni, Evan Suma

*Computer Animation and Virtual Worlds 2014, Proceedings of the 27th Conference on Computer Animation and Social Agents (CASA 2014)*, 05/2014

**[17] DEPTH SENSOR-BASED REALTIME TUMOR TRACKING FOR ACCURATE RADIATION THERAPY**

Björn Nutti, Åsa Kronander, Mattias Nilsing, Kristofer Maad, Cristina Svensson, Hao Li

*Eurographics 2014 Short Papers presented at the 35th Annual Conference of the European Association for Computer Graphics (Eurographics 2014 Short Papers)*, 04/2014

**[16] A STATISTICAL SHAPE MODEL OF TROCHLEAR DYSPLASIA OF THE KNEE**

Annemieke Van Haver, Peter Mahieu, Tom Claessens, Hao Li, Christophe Pattyn, Peter Verdonk, Emmanuel A. Audenaert

*The Knee Journal Elsevier (KNEE 2013)*, 12/2013

**[15] 3D SELF-PORTRAITS**

Hao Li, Etienne Vouga, Anton Gudym, Jonathan T. Barron, Linjie Luo, Gleb Gusev

*ACM Transactions on Graphics, Proceedings of the 6th ACM SIGGRAPH Conference and Exhibition in Asia (SIGGRAPH Asia 2013)*, 11/2013

**[14] REALTIME FACIAL ANIMATION WITH ON-THE-FLY CORRECTIVES**

Hao Li, Jihun Yu, Yuting Ye, Chris Bregler

*ACM Transactions on Graphics, Proceedings of the 40th ACM SIGGRAPH Conference and Exhibition (SIGGRAPH 2013)*, 07/2013

**[13] STRUCTURE-AWARE HAIR CAPTURE**

Linjie Luo, Hao Li, Szymon Rusinkiewicz

*ACM Transactions on Graphics, Proceedings of the 40th ACM SIGGRAPH Conference and Exhibition (SIGGRAPH 2013)*, 07/2013

**[12] TRACKING SURFACES WITH EVOLVING TOPOLOGY**

Morten Bojsen-Hansen, Hao Li, Chris Wojtan

*ACM Transactions on Graphics, Proceedings of the 39th ACM SIGGRAPH Conference and Exhibition (SIGGRAPH 2012)*, 08/2012

**[11] TEMPORALLY COHERENT COMPLETION OF DYNAMIC SHAPES**

Hao Li, Linjie Luo, Daniel Vlastic, Pieter Peers, Jovan Popović, Mark Pauly, Szymon Rusinkiewicz

*ACM Transactions on Graphics 31(1), Presented at the 39th ACM SIGGRAPH Conference and Exhibition (SIGGRAPH 2012)*, 08/2012

**[10] MAPPING CARDIAC SURFACE MECHANICS WITH STRUCTURED LIGHT IMAGING**

Jacob I. Laughner, Song Zhang, Hao Li, Connie C. Shao, Igor R. Efimov  
*American Journal of Physiology, Heart and Circulatory Physiology* 2012 Jul 13, PMID: 22796539  
 (AJP Heart 2012), 07/2012

**[9] MULTI-VIEW HAIR CAPTURE USING ORIENTATION FIELDS**

Linjie Luo, Hao Li, Sylvain Paris, Thibaut Weise, Mark Pauly, Szymon Rusinkiewicz  
*Proceedings of the 25th IEEE International Conference on Computer Vision and Pattern Recognition*  
 (CVPR 2012), 06/2012

**[8] FACTORED FACADE ACQUISITION USING SYMMETRIC LINE ARRANGEMENTS**

Duygu Ceylan, Niloy J. Mitra, Hao Li, Thibaut Weise, Mark Pauly  
*Computer Graphics Forum* 31(2), *Proceedings of the 33rd Annual Conference of the European Association for Computer Graphics* (Eurographics 2012), 05/2012

**[7] REALTIME PERFORMANCE-BASED FACIAL ANIMATION**

Thibaut Weise, Sofien Bouaziz, Hao Li, Mark Pauly  
*ACM Transactions on Graphics, Proceedings of the 38th ACM SIGGRAPH Conference and Exhibition*  
 (SIGGRAPH 2011), 08/2011

**[6] EXAMPLE-BASED FACIAL RIGGING**

Hao Li, Thibaut Weise, Mark Pauly  
*ACM Transactions on Graphics, Proceedings of the 37th ACM SIGGRAPH Conference and Exhibition*  
 (SIGGRAPH 2010), 07/2010

**[5] ROBUST SINGLE VIEW GEOMETRY AND MOTION RECONSTRUCTION**

Hao Li, Bart Adams, Leonidas J. Guibas, Mark Pauly  
*ACM Transactions on Graphics, Proceedings of the 2nd ACM SIGGRAPH Conference and Exhibition in Asia* (SIGGRAPH Asia 2009), 12/2009

**[4] FACE/OFF: LIVE FACIAL PUPPETRY (BEST PAPER AWARD)**

Thibaut Weise, Hao Li, Luc Van Gool, Mark Pauly  
*Proceedings of the 8th ACM SIGGRAPH / Eurographics Symposium on Computer Animation*  
 (SCA 2009), 08/2009

**[3] GLOBAL CORRESPONDENCE OPTIMIZATION FOR NON-RIGID REGISTRATION OF DEPTH SCANS**

Hao Li, Robert W. Sumner, Mark Pauly  
*Computer Graphics Forum* 27(5), *Proceedings of the 6th Eurographics Symposium on Geometry Processing* (SGP 2008), 07/2008

**[2] STRUCTURED LIGHT BASED RECONSTRUCTION UNDER LOCAL SPATIAL COHERENCE ASSUMPTION**

Hao Li, Raphael Straub, Hartmut Prautzsch  
*Proceedings of the 3rd IEEE International Symposium on 3D Data Processing, Visualization and Transmission* (3DPVT 2006), 06/2006

**[1] FAST SUBPIXEL ACCURATE RECONSTRUCTION USING COLOR STRUCTURED LIGHT**

Hao Li, Raphael Straub, Hartmut Prautzsch  
*Proceedings of the Fourth IASTED International Conference on Visualization, Imaging and Image Processing* (VIIP 2004), 09/2004

## COURSE NOTES, TECH TALKS &amp; EXHIBITIONS

**[20] PINSCREEN AVATARS IN YOUR POCKET: MOBILE PAGAN ENGINE AND PERSONALIZED GAMING**

Koki Nagano, Shunsuke Saito, Mclean Goldwhite, Kyle San, Aaron Hong, Liwen Hu, Lingyu Wei, Jun Xing, Qingguo Xu, Hanwei Kung, Jiale Kuang, Aviral Agarwal, Erik Castellanos, Jaewoo Seo, Jens Fursund, Hao Li  
*ACM SIGGRAPH Asia 2018 Real-Time Live!*, 12/2018

**[19] DEEP LEARNING-BASED PHOTOREAL AVATARS FOR ONLINE VIRTUAL WORLDS ON IOS**

Koki Nagano, Jaewoo Seo, Jun Xing, Kyle San, Aaron Hong, Mclean Goldwhite, Jiale Kuang, Aviral Agarwal, Caleb Arthur, Hanwei Kung, Stuti Rastogi, Carrie Sun, Stephen Chen, Jens Fursund, Hao Li  
*ACM SIGGRAPH 2018 Real-Time Live!, 08/2018*

**[18] TRUTH IN IMAGES, VIDEOS, AND GRAPHICS**

Chris Bregler, Alyosha Efros, Irfan Essa, Hany Farid, Ira Kemelmacher-Shlizerman, Matthias Nießner, Luisa Verdoliva, Hao Li  
*ACM SIGGRAPH 2018 Sunday Workshop, 08/2018*

**[17] PINSCREEN: CREATING PERFORMANCE-DRIVEN AVATARS IN SECONDS**

Hao Li, Liwen Hu, Koki Nagano, Jaewoo Seo, Shunsuke Saito, Lingyu Wei, Iman Sadeghi, Jens Fursund, Yen-Chun Chen, Stephen Chen, Carrie Sun  
*ACM SIGGRAPH 2017 Real-Time Live!, 08/2017*

**[16] PINSCREEN: 3D AVATAR FROM A SINGLE IMAGE**

Hao Li, Shunsuke Saito, Jens Fursund, Lingyu Wei, Liwen Hu, Chao Yang, Ronald Yu, Stephen Chen, Isabella Benavente, Yen-Chun Chen  
*ACM SIGGRAPH Asia 2016 Emerging Technologies, 12/2016*

**[15] GEOMETRIC DEEP LEARNING**

Jonathan Masci, Emanuelle Rodolà, Davide Boscaini, Michael M. Bronstein, Hao Li  
*ACM SIGGRAPH Asia 2016 Courses, 12/2016*

**[14] MODERN TECHNIQUES AND APPLICATIONS FOR REAL-TIME NON-RIGID REGISTRATION**

Andrea Tagliasacchi, Hao Li  
*ACM SIGGRAPH Asia 2016 Courses, 12/2016*

**[13] CANCER MOONSHOT: SXSL - MARKERLESS FACIAL PERFORMANCE CAPTURE**

Hao Li  
*SXSL South by South Lawn: A White House Festival of Ideas, Art, and Action, Interactive Exhibit, 10/2015*

**[12] CREATING AVATARS FROM A SINGLE IMAGE AND BRINGING THEM TO LIFE**

Hao Li, Shunsuke Saito  
*ACM SIGGRAPH 2016 Experience Presentations, 07/2016*

**[11] DIGITIZING THE HUMAN BODY: FROM VR, CONSUMER, TO HEALTH APPLICATIONS**

Hao Li, Tristan Swedish, Pratik Shah, Lingyu Wei, Ramesh Raskar  
*ACM SIGGRAPH 2016 Courses, 07/2016*

**[10] MODELING AND CAPTURING THE HUMAN BODY: FOR RENDERING, HEALTH, AND VISUALIZATION**

Hao Li, Anshuman Das, Tristan Swedish, Hyunsung Park, Ramesh Raskar  
*ACM SIGGRAPH 2015 Courses, 08/2015*

**[9] HOLOCHAT: 3D AVATARS ON MOBILE LIGHT FIELD DISPLAYS**

Jing Liu, Armand Niederberger, Jihun Yu, Hao Li, David Fattal  
*ACM SIGGRAPH 2015 Emerging Technologies, 08/2015*

**[8] DIGITAL IRA AND BEYOND: CREATING PHOTOREAL REAL-TIME DIGITAL CHARACTERS**

Javier von der Pahlen, Jorge Jimenez, Etienne Danvoye, Paul Debevec, Graham Fyffe, Hao Li  
*ACM SIGGRAPH 2014 Courses, 08/2014*

**[7] MAKE YOUR OWN AVATAR**

Ari Shapiro, Andrew Feng, Ruizhe Wang, Hao Li, Mark Bolas, Gerard Medioni, Evan Suma  
*ACM SIGGRAPH 2014 Real-Time Live!, 08/2014*



**[6] MEASUREMENT AND MODELING OF MICROFACET DISTRIBUTION UNDER DEFORMATION**

Koki Nagano, Oleg Alexander, Jernej Barbic, Hao Li, Paul Debevec  
*ACM SIGGRAPH 2014 Talks, 08/2014*

**[5] RAPID AVATAR CAPTURE AND SIMULATION USING COMMODITY DEPTH SENSORS**

Ari Shapiro, Andrew Feng, Ruizhe Wang, Hao Li, Mark Bolas, Gerard Medioni, Evan Suma  
*ACM SIGGRAPH 2014 Talks, 08/2014*

**[4] DYNAMIC GEOMETRY PROCESSING**

Will Chang, Hao Li, Niloy J. Mitra, Mark Pauly, Michael Wand  
*Eurographics 2012 Tutorial Notes, 05/2012*

**[3] KINECT-BASED FACIAL ANIMATION**

Thibaut Weise, Sofien Bouaziz, Hao Li, Mark Pauly  
*ACM SIGGRAPH Asia 2011 Emerging Technologies, 12/2011*

**[2] COMPUTING CORRESPONDENCES IN GEOMETRIC DATA SETS**

Will Chang, Hao Li, Niloy J. Mitra, Mark Pauly, Szymon Rusinkiewicz, Michael Wand  
*Eurographics 2011 Tutorial Notes, 04/2011*

**[1] GEOMETRIC REGISTRATION FOR DEFORMABLE SHAPES**

Will Chang, Hao Li, Niloy J. Mitra, Mark Pauly, Michael Wand  
*Eurographics 2010 Tutorial Notes, 05/2010*

TECHNICAL REPORTS & PATENTS

---

**[8] TECHNICAL PERSPECTIVE: PHOTOREALISTIC FACIAL DIGITIZATION AND MANIPULATION**

Hao Li  
*Communications of the ACM, January 2019, Vol. 62 No. 1*  
*(CACM 2019), 01/2019*

**[7] ON THE EFFECTS OF BATCH AND WEIGHT NORMALIZATION IN GENERATIVE ADVERSARIAL NETWORKS**

Sitao Xiang, Hao Li  
*arXiv:1704.03971*  
*(arXiv 2017), 04/2017*

**[6] INSPIRING COMPUTER VISION SYSTEM SOLUTIONS**

Julian Zilly, Amit Boyarski, Micael Carvalho, Amir Atapour Abarghouei, Konstantinos Amplianitis, Aleksandr Krasnov, Massimiliano Mancini, Hernán Gonzalez, Riccardo Spezialetti, Carlos Sampredo Pérez, Hao Li  
*arXiv:1707.07210*  
*(arXiv 2017 Best ICVSS Reading Group Prize), 07/2017*

**[5] BREAKING THE BARRIERS TO TRUE AUGMENTED REALITY**

Christian Sandor, Martin Fuchs, Alvaro Cassinelli, Hao Li, Richard Newcombe, Goshiro Yamamoto, Steven Feiner  
*arXiv:1512.05471*  
*(arXiv 2015), 12/2015*

**[4] REALTIME FACIAL ANIMATION WITH ON-THE-FLY CORRECTIVES**

Hao Li, Jihun Yu, Yuting Ye, Chris Bregler  
*US Patent (US14/141348), filed 08/2012*

**[3] A METHOD FOR FACIAL ANIMATION**

Thibaut Weise, Sofien Bouaziz, Hao Li, Mark Pauly  
*US Patent (US13/323231), filed 12/2011*

**[2] DYNAMIC HAIR CAPTURE**

Linjie Luo, Hao Li, Thibaut Weise, Sylvain Paris, Mark Pauly, Szymon Rusinkiewicz  
*Technical Report, Princeton University, 08/2011*

**[1] FIRST STEPS TOWARD THE AUTOMATIC REGISTRATION OF DEFORMABLE SCANS**

Hao Li, Mark Pauly  
*Technical Report, ETH Zurich, 06/2007*

THESES

---

**ANIMATION RECONSTRUCTION OF DEFORMABLE SURFACES**

Hao Li  
*PhD dissertation, ETH Zurich, 11/2010*

**REKONSTRUKTION FARBIGER OBJEKTE AUS STRUKTURIERT BELEUCHTETEN ANSICHTEN**

Hao Li  
*Diplomarbeit, Universität Karlsruhe (TH), 06/2005*

**RECONSTRUCTION USING STRUCTURED LIGHT**

Hao Li  
*Studienarbeit, Universität Karlsruhe (TH), 02/2004*

FILM CREDITS

---

<b>The Fifth Estate: The Deepfake</b> (CBC, Himself)	2018
<b>Follow This</b> (BuzzFeed/Netflix, Himself)	2018
<b>Blade Runner 2049</b> (USC Institute for Creative Technologies, Light Stage Processing Supervisor)	2017
<b>Valerian and the City of a Thousand Planets</b> (Vision & Graphics Lab, Director)	2017
<b>Furious 7</b> (Weta Digital, Researcher)	2015
<b>The Hobbit: The Battle of the Five Armies</b> (Weta Digital, Researcher)	2014
<b>Noah</b> (ILM, R&D)	2014
<b>Captain America: The Winter Soldier</b> (ILM, R&D)	2014
<b>Snickers - Hungry Face Morph</b>	2013
<b>Star Trek Into Darkness</b> (ILM, R&D)	2013
<b>The Lone Ranger</b> (ILM, R&D)	2013
<b>Pacific Rim</b> (ILM, R&D)	2013
<b>Space Pirate Captain Harlock</b>	2013
<b>G.I. Joe: Retaliation</b> (ILM, R&D)	2012
<b>Maatttraan</b>	2012
<b>Yellow</b>	2012
<b>3D Underwater Motion Capture of Dana Vollmer Olympic Gold Medalist</b>	2012

INVITED TALKS

---

**COMPLETE 3D HUMAN DIGITIZATION**

*Speaker, ONR HPT&E Technical Review: Warrior Resilience 2019, Orlando Science Center, Orlando, 02/2019*

**AI AND HUMAN DIGITIZATION: WHEN SEEING IS NOT BELIEVING?**

*Speaker, DARPA MediFor PI Meeting 2019, DARPA Conference Center, Arlington, 02/2019*

*Speaker, EmTech Asia 2019, Singapore, 01/2019*

*Keynote Speaker, DISRUPT.SYDNEY 2018, Sydney, 09/2018*

*Speaker, IET EngTalks, London, 09/2018*

**PHOTOREALISTIC HUMAN DIGITIZATION AND RENDERING USING DEEP LEARNING**

*Speaker, Softbank Open Innovation The Second BBM Summit 2018, Hakodate, 12/2018*



*Invited Talk, Sony Corporation, Tokyo, 12/2018*  
*Invited Talk, Waseda University, Tokyo, 12/2018*  
*Keynote Speaker, VRST 2018, Tokyo, 12/2018*  
*Invited Talk, Dreamscape Immersive, Los Angeles, 08/2018*  
*Invited Talk, Amazon, Seattle, 08/2018*  
*Speaker, US Army TRADOC Workshop 2018, Los Angeles, 08/2018*  
*Speaker, Machine Learning for 3D Understanding, TUM Institute for Advanced Study, Munich, 07/2018*  
*Speaker, Sixth International Workshop on Computer Vision 2018, Modena, 05/2018*  
*Keynote Speaker, CMS Meeting of the Minds, Caltech, Pasadena, 05/2018*

#### **THE FUTURE OF MIXED REALITY**

*Speaker, First CONIX Annual Review 2018, Carnegie Mellon University, Pittsburgh, 09/2018*

#### **3D AVATARS, VIRTUAL REALITY, AND DEEP LEARNING**

*Speaker, USC London Delegation Trip 2018, London, 02/2018*

#### **THE FUTURE OF FAKE NEWS**

*Speaker, World Congress of Science and Factual Producers, San Francisco, 12/2017*

#### **VIRTUAL AVATAR CREATION USING DEEP LEARNING**

*Speaker, SIGGRAPH Asia Symposium on AR and VR 2017, Bangkok, 12/2017*

#### **DIGITAL HUMAN TELEPORTATION USING DEEP LEARNING**

*Speaker, USC Viterbi Corporate Advisory Board Meeting, Los Angeles, 04/2018*  
*Keynote Speaker, CVMP 2017, London, 11/2017*  
*Speaker, Sony US Research Center, San Jose, 11/2017*  
*Keynote Speaker, SoftBank Ventures Forum 2017, Seoul, 10/2017*  
*Speaker, USC China Miniforum, Los Angeles, 9/2017*  
*Speaker, SCA 2017 Symposium on Computer Animation, Los Angeles, 7/2017*  
*Speaker, ICVSS 2017 International Computer Vision Summer School, Sicily, 7/2017*  
*Keynote Speaker, ACM SIGGRAPH Taipei Chapter Computer Graphics Workshop 2017, Taichung, 6/2017*  
*Keynote Speaker, S3PM 2017 International Convention on Shape, Solid, Structure, & Physical Modeling, Berkeley, 6/2017*  
*Speaker, FMX 2017, Stuttgart, 05/2017*  
*Invited Talk, Ochanomizu University, Tokyo, 2/2017*

#### **CAPTURE, RENDERING, AND DISPLAY FOR VIRTUAL HUMANS**

*Speaker, UARC ICT Mission Projects 2017, Los Angeles, 02/2017*

#### **LEARNING CORRESPONDENCES BETWEEN CLOTHED HUMAN SHAPES**

*Speaker, ECCV Workshop on Geometry Meets Deep Learning 2016, Amsterdam, 10/2016*

#### **MARKERLESS MOTION CAPTURE**

*Speaker, Human Performance, Training & Education Tech Review, Quantico US Marine Corps Base, Stafford County, 10/2016*

#### **REAL-TIME FACIAL MOTION CAPTURE AND ITS APPLICATIONS**

*Speaker, 4th Huawei Smart Device Summit on Multimedia Technology, Shenzhen, 09/2016*

#### **DEMOCRATIZING HUMAN DIGITIZATION**

*Invited talk, Nickelodeon Animation Studio, Burbank, 02/2017*  
*Keynote Speaker, SIGGRAPH Asia Workshop on Virtual Reality Meets Physical Reality 2016, Macao, 12/2016*  
*Speaker, The Real Deal @ USC, Los Angeles, 11/2016*  
*Speaker, TEDxHollywood, Los Angeles, 09/2016*

#### **DEEP LEARNING: A NEW TOOL FOR CONTENT CREATION AND GAME DESIGN**

*Speaker, SIGGRAPH 2016 Special Session, Open Problems in Real-Time Rendering, Anaheim, 07/2016*

**TÊTE-À-TÊTE IN CYBERSPACE***Speaker, Fifth International Workshop on Computer Vision 2016, Lecce, 05/2016***DIGITIZING HUMANS INTO VR USING DEEP LEARNING***Speaker, REAL 2016, San Francisco, 3/2016**Speaker, NVidia Deep Learning Workshop, Los Angeles, 02/2016***MARKERLESS PERFORMANCE CAPTURE FOR AUTOMATED FUNCTIONAL MOVEMENT SYSTEM***Speaker, Warrior Resilience Tech Review, Office of Naval Research, Arlington, 02/2016***BRIDGING PHYSICAL AND DIGITAL WORLDS***Speaker, 16th KOCSEA Technical Symposium 2015, Harvey Mudd College, Claremont, 12/2015**Speaker, SLUSH Conference 2015, Helsinki, 11/2015**Speaker, USC Global Conference 2015, Shanghai, 10/2015***HUMAN DIGITIZATION AND FACIAL PERFORMANCE CAPTURE FOR SOCIAL INTERACTIONS IN VR***Speaker, VRLA Winter Expo, Los Angeles, 01/2016**Invited Talk, Google, Seattle, 10/2015**Invited Talk, Disney Consumer Products, Glendale, 07/2015**Invited Talk, MIT Computer Graphics Group, Massachusetts Institute of Technology, Cambridge, 06/2015***SOCIAL INTERACTION IN CYBERSPACE***Speaker, SLUSH Future Brunch, No Name Club, Los Angeles, 05/2015***DATA-DRIVEN HAIRSTYLING***Speaker, Workshop on Functoriality in Geometric Data 2015, HKUST IAS, Hong Kong, 04/2015***IMMERSIVE TELEPRESENCE WITH 3D SENSING AND VR HMD***Speaker, USC Integrated Media Systems Center Retreat 2015, Los Angeles, 04/2015***DEMOCRATIZING 3D HUMAN CAPTURE: GETTING HAIRY!***Invited Talk, Google, Mountain View, 09/2015**Speaker, Rotary Club, Santa Monica, 09/2015**Invited Talk, Intel, Santa Clara, 06/2015**Invited Talk, Apple, Cupertino, 05/2015**IST Lunch Bunch, Caltech, Pasadena, 05/2015**Invited Talk, SnapChat, Venice, 04/2015**Speaker, LA ACM SIGGRAPH Innovative Research in Computer Graphics at USC and ICT, Los Angeles, 03/2015**Keynote Speaker, International Conference on 3D Vision, Tokyo, 12/2014**Keynote Speaker, ACM SIGGRAPH Conference on Motion in Games 2014, Los Angeles, 11/2014***THE FUTURE OF EXPERIENCING REALITY***Speaker, New York Global Conversation 2014, New York, 10/2014***ON THE FUTURE OF DIGITAL CHARACTERS***Keynote Speaker, Vivid Sydney, Sydney, 06/2014***HUMAN CAPTURE WITH DEPTH SENSORS***Keynote Speaker, Making Augmented Reality Real, NAIST, Nara 08/2014**Invited Talk, Victoria University, Wellington, 07/2014**Chalk Talk, Weta Digital, Wellington, 07/2014**Invited Talk, Pelican Imaging Corporation, Mountain View, 05/2014***3D SELFIES!***Speaker, Depth Camera Birds of Feather, SIGGRAPH 2014, Vancouver, 08/2014**Speaker, FMX 2014, Stuttgart, 04/2014*

**DEMOCRATIZING 3D SCANNING FOR 3D PRINTING***Speaker, USC Trustee Conference, La Quinta, 03/2014***3D HUMAN CAPTURE: FROM VFX TO THE MAINSTREAM***Speaker, Interactive Media Forum, USC's School of Cinematic Arts, Los Angeles, 04/2014**Speaker, CESASC 52nd Annual Convention, San Gabriel, 04/2014**Invited Talk, University of California, Santa Barbara, 02/2014***HOW DEPTH SENSING TECHNOLOGY WILL CHANGE US***Speaker, Tech Plus Forum (tech+), Seoul, 11/2013***DEMOCRATIZING HUMAN CAPTURE***TR35 Talk, EmTech MIT 2013, Cambridge, 10/2013***3D HUMAN CAPTURE FOR EVERYONE***Invited Talk, SIAT Chinese Academy of Sciences, Shenzhen, 11/2013**Invited Talk, Harvard University, Cambridge, 10/2013***LOW-IMPACT HUMAN DIGITIZATION AND PERFORMANCE CAPTURE***Invited Talk, Dreamworks Animation, Glendale, 08/2013***DIGITIZING HUMANS IN MOTION FROM A GEOMETRIC PERSPECTIVE***3D Imaging and Computing 2012, National Chiao Tung University, Hsinchu, 12/2012***DYNAMIC SHAPE RECONSTRUCTION AND TRACKING***R&D Forum, Industrial Light & Magic, Letterman Digital Arts Center, San Francisco, 04/2012***GEOMETRIC CAPTURE OF HUMAN PERFORMANCES***Faculty Candidate Seminars, Department of Computer Science, Columbia University, New York, 03/2012**Guest Presentation, Rhythm & Hues Studios, Los Angeles, 03/2012**Chalk Talk, Digital Domain, Venice, 03/2012**CS Colloquium Series, Computer Science Department, University of Southern California, Los Angeles, 03/2012***MAYA FOR GRAPHICS SCIENTISTS***Invited Talk, Princeton Computer Graphics Group, Princeton University, New Jersey, 02/2012***TRACKING DEFORMABLE SURFACES***Computer Graphics Reading Group, University of Pennsylvania, Philadelphia, 01/2012***CAPTURING 3D ANIMATION FOR ENTERTAINMENT AND SCIENCES***CVGC Seminar, Columbia Computer Graphics Group, Columbia University, New York, 12/2011***DYNAMIC SHAPE CAPTURE WITH APPLICATIONS IN ART AND SCIENCES***Invited Talk, Microsoft, Redmond, 11/2011***NON-RIGID REGISTRATION IN ENTERTAINMENT AND SCIENCE***Invited Talk, Department for Perceiving Systems, Max-Planck-Institut für Intelligente Systeme, Tübingen, 09/2011***HUMAN BODIES, FACES, AND HAIR***Guest Lecture, Courant Institute of Mathematical Sciences, New York University, New York, 09/2011***ROBUST NON-RIGID 3D ALIGNMENT AND APPLICATIONS***R&D Seminar, Vision Technologies, SRI International/Sarnoff Corporation, New Jersey, 07/2011*

**CAPTURE, RECONSTRUCT, TRACK, RIG, RETARGET!***Invited Talk, Princeton Computer Graphics Group, Princeton University, New Jersey, 08/2010***INVERSE ENGINEERING DYNAMIC SHAPES FOR COMPUTER ANIMATION***Invited Talk, Courant Institute of Mathematical Sciences, New York University, New York, 08/2010***ANIMATION RECONSTRUCTION***Invited Talk, Columbia Computer Graphics Group, Columbia University, New York, 08/2010***GENERATING BLENDSHAPES FROM EXAMPLES AND CAPTURING WATERTIGHT HUMAN PERFORMANCES***R&D Seminar, Industrial Light & Magic, Letterman Digital Arts Center, San Francisco, 08/2010***A PRACTICAL FACIAL ANIMATION SYSTEM: FROM CAPTURE TO RETARGETING***Research Seminar, Pixar Animation Studios, Emeryville, 08/2010***ART-DIRECTABLE AND DATA-DRIVEN FACIAL ANIMATION***Invited Talk, Institute of Animation, Visual Effects and Digital Postproduction, Filmakademie Baden-Württemberg, Ludwigsburg, 05/2010***ROBUST RECONSTRUCTION OF DYNAMIC SHAPES AND REAL-TIME FACIAL ANIMATION***Invited Talk, Institute for Creative Technologies, University of Southern California, Marina del Rey, 11/2009***DEFORMING GEOMETRY RECONSTRUCTION AND LIVE FACIAL PUPPETRY***R&D Seminar, Industrial Light & Magic, Letterman Digital Arts Center, San Francisco, 10/2009***ANIMATION RECONSTRUCTION FROM A SINGLE-VIEW***Invited Talk, Computer Graphics Department, Max-Planck-Institut für Informatik, Saarbrücken, 05/2009***ACTIVE SHAPE ACQUISITION: FROM IMAGES TO 3-D SURFACES***Invited Talk, Graduate School of Global Information and Telecommunication Studies, Waseda University, Tokyo, 06/2006***3D SCANNING FOR EVERYONE***Ninth SIAM Conference on Geometric Design and Computing (SIAM-GD'05), Phoenix, Arizona, 10/2005***SURFACE RECONSTRUCTION USING COLORED STRIPE PROJECTIONS***Graphics Lunch Seminar, Computer Graphics Laboratory, ETH Zurich, 09/2005***REKONSTRUKTION MIT STRUKTURIERTEM LICHT***First Status Report Meeting of the Institute for Scientific Computing and Mathematical Modeling, Universität Karlsruhe (TH), 04/2005***SOFTWARE & DATASETS**

---

**Pinscreen**<http://www.pinscreen.com>

A mobile app that allows anyone to instantly create a 3D avatar by uploading a selfie or an arbitrary 2D photograph. The avatar can then be animated using the phone camera and produce AR selfie content or Animojis. The software can be downloaded from Apple's App Store and has been developed by the entire Pinscreen team.

**USC-HairSalon**

A large publicly accessible 3D hairstyle database for hair capture, modeling, simulation, and rendering research. This data collection is also a great resource for benchmark and evaluation purposes. My co-authors are Liwen Hu, Chongyang Ma, and Linjie Luo.

**Shapify.me**

<http://www.shapify.me>

*A free application for creating 3D self-portraits directly using Microsoft's Kinect sensor. A person rotates in front of the sensor and the software automatically produces a complete textured digital model of the person. The 3D model can be uploaded to a server and 3D printed. My co-authors are E. Vouga, A. Gudym, and G. Gusev.*

**ILM's Monster Mirror**

*Industrial Light & Magic's proprietary depth sensor-driven real-time facial animation system for instantaneous high fidelity facial performance capture for virtual filmmaking. The calibration-free system sets the current bar for realtime facial tracking accuracy and robustness. I co-developed the software with J. Yu, Y. Ye, and C. Bregler.*

**BeNTO 3D**

<http://www.bento3d.com>

*An easy to use geometry processing application created exclusively for Mac. The Cocoa based tool distinguishes from other competitors in that development of additional plugins and GUI extensions are considerably simplified.*

**faceshift**

<http://www.faceshift.com>

*A software for real-time and markerless facial performance capture using Microsoft's Kinect sensor. The Qt-based application runs on Mac OS X and Windows 7 and is co-developed with T. Weise and S. Bouaziz. Faceshift has been acquired by Apple Inc. and its technology has been incorporated into the iPhone X.*

**Artec Studio**

<http://www.artec3d.com>

*Development of a state-of-the-art geometry processing pipeline for aligning and merging non-rigid 3D scan data.*

PROFESSIONAL ACTIVITIES

---

**Co-Curator and Member of the Global Future Councils**

World Economic Forum (WEF) - Virtual and Augmented Reality Transformation Maps 2017, 2018, and 2019

**Associate Editor**

Computer Graphics Forum 2016-2019

**Co-Organizer**

CONIX Mixed Reality Workshop 2018, USC Institute for Creative Technologies, Playa Vista, 08/2018

**Program Committee (Computer Graphics)**

ACM SIGGRAPH 2015 and 2016

ACM SIGGRAPH Asia 2017 and 2018

ACM SIGGRAPH Asia (Technical Briefs & Posters) 2014, 2015, and 2016

ACM SIGGRAPH Asia (E-Tech) 2013, 2014, 2015, and 2016

ACM SIGGRAPH Asia (Symposium in Mobile Graphics and Interactive Applications) 2015

Symposium on Computer Animation 2013, 2014, 2015, 2016, 2017, and 2018

Symposium on Geometry Processing 2012, 2016, 2017, 2018, and 2019

Eurographics 2014, 2015, and 2016

Eurographics (STAR) 2015

Eurographics (Short Papers) 2013, 2014, and 2015

Pacific Graphics 2012, 2013, 2014, 2015, 2016, 2017, and 2019

Shape Modeling International 2013 and 2017

International Conference on Computer Aided Design and Computer Graphics 2013 and 2015

International Conference on Computer Animation and Social Agents 2014, 2015, and 2016

**Program Committee (Computer Vision)**

IEEE International Conference on Computer Vision and Pattern Recognition 2017, and 2018

IEEE CVPR Workshop on Morphable Face Models: from Present to Future 2018

International Conference on 3D Vision 2014 and 2015

International Symposium on 3D Data Processing, Visualization and Transmission 2010

Workshop on Non-rigid Shape Analysis and Deformable Image Alignment 2010, 2011, 2012, and 2014

#### **Reviewer**

ACM SIGGRAPH 2008, 2009, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, and 2019

ACM SIGGRAPH Asia 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, and 2018

ACM Transaction on Graphics 2010, 2011, 2013, 2015, 2016, 2017, and 2018

IEEE International Conference on Computer Vision and Pattern Recognition 2016, 2017, 2018, and 2019

International Conference on Computer Vision 2017 and 2019

European Conference on Computer Vision 2016

ACM User Interface software and Technology Symposium 2014

Symposium on Computer Animation 2013, 2014, 2015, 2016, 2017, and 2018

Symposium on Geometry Processing 2007, 2008, 2012, 2016, 2017, 2018, and 2019

Eurographics 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, and 2017

Computer Graphics Forum 2010, 2011, 2016, 2017, and 2018

International Conference on 3D Vision 2014 and 2015

Workshop for Women in Machine Learning 2018

IEEE International Symposium on mixed and Augmented Reality 2015

3D Data Processing, Visualization and Transmission 2010

Non-rigid Shape Analysis and Deformable Image Alignment 2010, 2011, 2012, and 2014

Transactions on Visualization and Computer Graphics 2009, 2012, 2013, 2014, 2015, 2016, 2017, and 2018

Transactions on Pattern Analysis and Machine Intelligence 2007, 2012, and 2017

International Journal of Computer Vision 2015

IEEE Computer Graphics and Applications 2013

International Conference on Computer Animation and Social Agents 2014, 2015, and 2016

EURASIP Journal on Advances in Signal Processing 2011

Graphical Models 2014

Computers & Graphics 2013 and 2014

Asian Conference on Computer Vision 2010

Pacific Graphics 2009, 2011, 2012, 2013, 2014, 2015, 2016, and 2017

Vision, Modeling, and Visualization Workshop 2006

Geometric Modeling and Processing 2006

Computer-Aided Design 2013

#### **Chair**

International Conference on 3D Vision 2019 Area Chair

International Conference on 3D Vision 2017 Area Chair

SIGGRAPH Asia 2018 Session Chair

SIGGRAPH Asia 2017 Session Chair

SIGGRAPH 2017 Session Chair

SIGGRAPH 2016 Session Chair

SIGGRAPH 2015 Session Chair

SIGGRAPH Asia (E-Tech) Prize 2013 and 2014

International Conference on 3D Vision 2015 Area Chair

#### **Panels**

Judge's Panel for the MIT TR 35 Innovators of 2019

03/2019

National Science Foundation (FW-HTF) Research Proposal

07/2018

Judge's Panel for the MIT TR 35 Innovators of 2018

03/2018

Qiu Shi Outstanding Young Scholar Award Selection Committee

05/2017

Judge's Panel for the MIT TR 35 Innovators of 2017

05/2017

European Research Council Research Proposal

12/2016

Judge's Panel for the MIT TR 35 Innovators of 2016

05/2016

European Research Council Research Proposal

12/2015



Judge's Panel for the MIT TR 35 Innovators of 2015	04/2014
Swiss National Science Foundation Research Proposal	12/2014
Judge's Panel for the MIT TR 35 Innovators of 2014	05/2014

**Membership**

World Economic Forum Global Future Councils	11/2018 - ongoing
ACM SIGGRAPH	06/2006 - ongoing
Eurographics Association	08/2011 - ongoing
National Academy of Inventors	05/2017 - ongoing
World Future Society	08/2017 - ongoing

**BOARD**

Tekcapital, Scientific Advisory Board	08/2017
European Conference on Visual Media Production, Scientific Advisory Board	02/2017
Pinscreen Inc., Board of Director	10/2015
Pelican Imaging, Technical Advisory Board	09/2014 - 11/2016

**EXTRACURRICULAR ACTIVITIES**

World Economic Forum, Annual Meeting of the Global Future Councils, Dubai	11/2018
Lucasfilm Training LDAC, Practical & CG Cinematography, San Francisco	08/2009
Credit Suisse Group, Equity Derivatives Workshop, Zurich	03/2008
McKinsey&Company, Business Technology Office's European Seminar, Portugal	05/2007

**TECHNICAL SKILLS****Operating Systems**

Mac OS X, Linux/Unix, and Windows

**Programming Languages**

C/C++, Objective C, Python, Java, and HTML/CSS

**Professional Tools**

Unity, Autodesk Maya, Autodesk 3ds MAX, Pixologic ZBrush, Zeno, Adobe AfterEffects, Adobe Premiere, Adobe Photoshop, and Adobe Illustrator

**MILITARY SERVICE**

<b>German Federal Armed Forces</b>	11/1999 - 08/2000
Division for Special Operations (DSO) - Airborne Brigade 26	
2 <sup>nd</sup> Company of the Antitank Parachute Battalion 262, Merzig, Germany	
<ul style="list-style-type: none"> <li>German parachutist badge in bronze</li> </ul>	

**REFERENCES****Prof. Dr. Leonidas J. Guibas**Paul Pigott Professor of Computer Science and Electrical Engineering  
Stanford University, Computer Science Department**Email** guibas@cs.stanford.edu**Home page** http://geometry.stanford.edu/**Prof. Dr. Wojciech Matusik**Associate Professor of Computer Science  
Massachusetts Institute of Technology, Department of Electrical Engineering and Computer Science**Email** wojciech@mit.edu**Home page** http://people.csail.mit.edu/wojciech

Hao Li

26

**Prof. Dr. Michael J. Black**

Director and Distinguished Amazon Scholar  
Max Planck Institute for Intelligent Systems, Perceiving Systems Department

**Email** black@tuebingen.mpg.de

**Home page** <http://ps.is.tue.mpg.de>

**Dr. Chris Bregler**

Senior Staff Scientist  
Google AI

**Email** bregler@google.com

**Home page** <http://chris.bregler.com/>

**Kim Librer**

Chief Technology Officer  
Epic Games

**Email** available upon request

**Home page** <http://epicgames.com/>